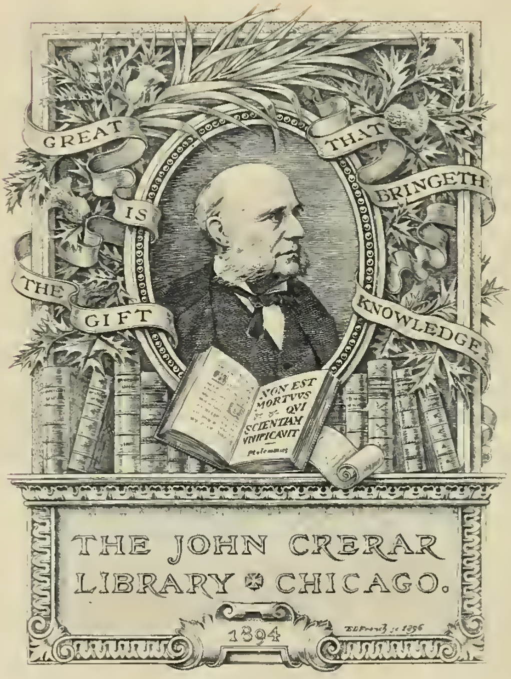
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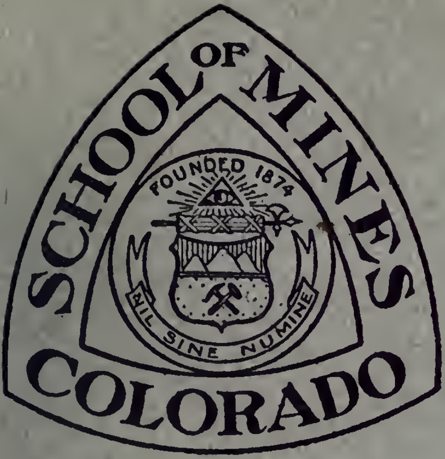

QUARTERLY

Vol. 1. No. 2.

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QUARTERLY

OF THE

COLORADO SCHOOL OF MINES.

Vol. I. No. 2.

Catalogue Edition.

GOLDEN, COLORADO.
1906-1908

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COLLEGE CALENDAR.

1906.

November	29	Thursday	Thanksgiving Recess.
November	30	Friday	
December	24	Monday	Christmas Recess Begins.

1907.

January	5	Saturday	Christmas Recess Ends.
January	19	Saturday	First Semester Ends.
January	21	Monday	Second Semester Begins.
February	22	Friday	Washington's Birthday. (A Holiday.)
May	24	Friday	Second Semester Ends. Commencement Exercises.
May	27	Monday	Field Surveying Begins.
June	22	Saturday	Field Surveying Ends.
August	28	Wednesday	Examinations for Entrance to the Class of 1911 and Re-examination of Matriculated Students.
August	29	Thursday	
August	30	Friday	
September	3	Tuesday	Opening of the First Semester of the Academic Year, 1907-8.
November	28	Thursday	Thanksgiving Recess.
November	29	Friday	
December	23	Monday	Christmas Recess Begins.

1908.

January	4	Saturday	Christmas Recess Ends.
January	18	Saturday	First Semester Ends.
January	20	Monday	Second Semester Begins.
February	22	Saturday	Washington's Birthday. (A Holiday.)
May	22	Friday	Second Semester Ends. Commencement Exercises.
May	25	Monday	Field Surveying Begins.
June	20	Saturday	Field Surveying Ends.
August	27	Wednesday	Examination for Entrance to the Class of 1912 and Re-examination of Matriculated Students.
August	28	Thursday	
August	29	Friday	
September	2	Tuesday	Opening of the First Semester of the Academic Year 1908-9.

BOARD OF TRUSTEES.

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Term expires, 1907.

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Term expires, 1909.

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Term expires, 1909.

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Term expires, 1907.

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Term expires, 1907.

Treasurer,
HARRY M. RUBEY, Woods-Rubey National Bank,
Golden, Colo.

The regular meetings of the Board of Trustees are held in Golden, at the School of Mines, on the second Thursday of each month.

FACULTY.

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Secretary to the President.

A. C. ELLSWORTH, B. S.,
Director of Athletics.

COMMITTEES OF THE FACULTY.

Admission,
Professors Burger, Wolcott, and Mr. Bailar.

Catalogue,
Professors Fleck, and Young.

Buildings and Grounds,
Professors Patton, Allison, and Cronin.

Library,
Professor Young, Mr. A. C. Smith, and Miss Shrum.

Athletics,
Professors Patton, Fleck, and Haldane.

Theses,
Professors Traphagen, Patton, and Young.

Bulletin,
Professors Hazard, Young, and Mr. C. E. Smith.

Student Societies,
PROFESSORS HAZARD, YOUNG, AND C. E. SMITH.

The President is *ex officio* a member of all committees.

HARRY ALLEN,
Chief Engineer.

JOHN HULT,
Superintendent of Grounds.

N. L. JENNINGS,
Superintendent of Machinery.

H. J. GUTH,
Pattern Maker.

J. T. STEWART,
Store Keeper.

SPECIAL LECTURERS.

FREDERICK M. TISDELL, Ph. D., Laramie, Wyoming.
President of the University of Wyoming.
The Relation of Technical to Cultural Education.

JOSEPH S. JAFFA, LL. B., Denver Colorado.
Member of the Board of Trustees.
The Incorporation of Companies.

THOMAS TONGE, Denver, Colorado.
Representative of the *Mining Journal,* London, England.
Legitimate versus Illegitimate Mining.

JAMES UNDERHILL, Ph. D., Idaho Springs, Colo.
Deputy Mineral Surveyor.
The Geology of the Clear Creek District.

A. L. ROHRER, Schenectady, New York.
Superintendent, General Electric Company.
The Applications of Electricity.

MORRILL D. STACKPOLE, Denver, Colorado.
Gold and Silver Extraction Company of America (Lim.).
The Cyanide Treatment of Gold and Silver Ores.

LESTER McLEAN, Colorado Springs, Colorado.
Secretary, International Committee, Y. M. C. A.
Student and Army Life in Japan.

L. O. EVANS, Butte, Montana.
Counsel, Boston and Montana Consolidated Silver and Copper Mining Company.
Extralateral Rights in Montana.

A. W. WARWICK, E. M., Denver, Colorado.
Mining Engineer.
Mexican Mining Methods.

LEWIS B. SKINNER, E. M., Denver, Colorado.
Western Chemical Company.
Chlorination.

GEO. W. SCHNEIDER, E. M., Denver, Colorado.
Deputy Commissioner of Mines.
Practices of the State Bureau of Mines.

HORACE V. WINCHELL, Ph. D., Butte, Montana.
Geologist, Anaconda Copper Mining Company.
The Geology of Butte, Montana.

HON. C. F. KELLY, Butte, Montana.
Counsel, Amalgamated Copper Mining Company.
Mining Litigation.

C. D. DEMOND, Anaconda, Montana.
Testing Engineer, New Reduction Works, Anaconda Copper Mining Company.
The Work of the Testing Department of the Anaconda Copper Mining Company.

R. H. SALES, E. M., Butte, Montana.
Assistant Geologist, Anaconda Copper Mining Company.
Mining Geology.

B. H. DUNSHEE, Butte, Montana.
Assistant Superintendent, Amalgamated Copper Mining Company.
Sinking a Permanent Shaft.

J. T. ROBERTS, Anaconda Montana.
Chief Clerk, New Reduction Works.
Accounting in a Large Smelter.

E. P. MATHEWSON, Anaconda, Montana.
Manager, New Reduction Works, Anaconda Copper Mining Company.
The Organization of a Large Smelter.

GEORGE F. SHELTON, Butte, Montana.
Counsel for W. A. Clark Interests.
Mining and Agriculture.

WILLIAM WRAITH, E. M., Anaconda, Montana.
Assistant Superintendent, New Reduction Works, Anaconda Copper Mining Company.
The Organization of the New Reduction Works.

J. C. REPATH, Anaconda, Montana.
Mechanical Engineer, New Reduction Works, Anaconda Copper Mining Company.
The Importance of Mechanical Engineering in Metallurgical Plants.

SAMUEL BARKER, Jr., E. M., Butte, Montana.
Of Barker & Wilson, Civil and Mining Engineers.
The Plumbing of a Shaft.

PROFESSOR GEORGE C. CRAVEN, Butte, Montana.
Professor of Electrical Engineering, Montana School of Mines.
Hydro-Electric Development in Montana.

H. C. PARMELEE, Denver, Colo.
Editor of *The Mining Reporter.*
The Progress of Metallurgical Processes in Colorado.

C. W. GOODALE, Butte, Montana.
General Manager, Boston and Montana Consolidated Copper and Silver Company.
Mining and Metallurgy, Past and Present.

HISTORY, ORGANIZATION, FINANCIAL SUPPORT, AND LOCATION.

HISTORY.

The Colorado School of Mines was established by an act of the Territorial Legislature, approved February 9, 1874. After an unsatisfactory experience in temporary quarters, the School was permanently housed in the original "building of 1880," upon land given by the citizens of Golden. Since then the School has enjoyed a strong and steady growth in buildings, in equipment, in students, in Faculty, and in the strength and rigor of its courses. Additions were made to the original building of 1880, by the buildings of 1882, and by the building of 1890. Engineering Hall was erected in 1894, the Stratton Assaying Laboratory in 1900, and the new hall for Mining and Metallurgy, called Stratton Hall, was completed in 1904. The Heating, Lighting, and Power Plant was completed in 1906. The new Administrative Building, named Simon Guggenheim Hall, for the donor, was also erected in 1906.

ORGANIZATION.

The corporate name of the institution by statute is "The School of Mines." The general management of the Colorado School of Mines is vested by statute in a Board of Trustees, consisting of five members appointed by the Governor of the State with the advice and consent of the Senate. The members of the Board of Trustees are appointed in alternating sets of two and three, and hold their office for a period of four years and until their successors are appointed and qualified. The Board of Trustees elect one of their number President. They also appoint a Secretary and Treasurer either from their own number, or from some other suitable persons as they may deem best. Any three of said Board of Trustees constitute a quorum for the transaction of business. The President of the Faculty of the School, who shall be appointed by the said Board of Trustees, shall be known as "President of the School of Mines." By the organic Constitution of Colorado, the School of Mines is regarded as an Institution of the State.

FINANCIAL SUPPORT.

The Colorado School of Mines is supported by the income derived from the annual tax of one-fifth of a mill on each dollar of the assessed property of the State, and this is known as the "School of Mines Tax." In addition to this the Legislature has from time to time provided by special appropriation for such emergency funds as the means of the State treasury and the necessities of the School might suggest.

LOCATION.

The Colorado School of Mines is in the south central part of the city of Golden, Jefferson County. Golden is about thirteen miles from Denver, and can be reached by the Colorado and Southern Railroad from the Union Station at the foot of Seventeenth Street, by the Denver and Intermountain Railway, from the Arapahoe Street Station, between Fourteenth and Fifteenth Streets, or by the Denver and Northwestern Electric Railway, from the Loop on Fifteenth Street, between Arapahoe and Lawrence Streets, Denver.

Golden has about three thousand inhabitants and is one of the oldest cities in Colorado. It is such a residence town as usually clusters around a college, and is the most available mountain or foot-hill home surburban to and available from Denver. The altitude is five thousand seven hundred feet above sea level, or about four hundred fifty feet higher than Denver. The climate is invigorating and pleasant, with open winters and a large proportion of clear days. The surrounding region is rich in the characteristic scenery of the Rocky Mountain region.

The Colorado School of Mines is peculiarly well located to give students both a theoretical and practical training. The equipment of the school enables the theoretical side to be well presented. The nearness to mines, mills, and smelters offers unusual opportunities for inspection visits, and enables the student to see in actual operation every variety of mining and metallurgical work. The Independent Pyritic Smelter is located at Golden. In the Clear Creek canon are the numerous gold mills and concentrators of Gilpin and Clear Creek counties. At Argo, near Denver, the Boston and Colorado Smelting Company illustrates the metallurgy of gold, silver, and copper ores. At the Globe plant of the American Smelting and Refining Company the treatment of lead ores and dry ores of gold and silver is illustrated by up-to-date methods. At Denver also are the Colorado Zinc works, using the most modern methods of magnetic and electric separation, and in addition there are numerous sampling and ore testing works. The many mining and metallurgical machinery plants of Denver also afford an excellent opportunity for becoming acquainted with recent improvements in metallurgical design. At Colorado City are the Portland and Standard mills for the chlorination treatment of gold ores, and the Golden Cycle Mill for cyanidation; at Cripple Creek, the Cripple Creek and Homestake mills; and at Florence, the Union mill. The plant of the Colorado Fuel and Iron Company at Pueblo possesses all the recently invented and approved devices for the production of iron and steel and for working these products into marketable forms. At Pueblo there are also three lead smelters, the Pueblo, Eilers and Philadelphia, and the zinc smelter of the Colorado Zinc Company. At Canon City are the plants of the Empire Zinc Company and of the United States Reduction and Refining Company, and at Leadville, the Arkansas Valley smelter. The Black Hills, where good practice in gold milling and cyanidation is to be found, and the great copper smelters of Montana, are visited on longer trips.

At or near Golden are numerous clay mines and quarries and extensive coal mines well equipped with hoisting and power machinery. In the Clear Creek canon, within a short ride of Golden, are the mining camps of Central City, Black Hawk, Idaho Springs and Georgetown, and placer mining at Breckenridge. The well-known mining camps of Cripple Creek, Victor, Leadville and Aspen, as well as the San Juan region, including Silverton, Ouray and Telluride, are also easily reached by train from Denver. Besides these there are also available the bituminous mines of the Northern Coal Fields, the anthracite fields of Glenwood Springs, the oil fields of Florence, the iron mines of Wyoming, and the copper regions of Arizona and Montana.

No other mining school in the country has within easy access such a wide variety of mining properties, or such excellent opportunities for observing the latest and best smelting operations.

REQUIREMENTS FOR ADMISSION.

FRESHMAN CLASS.

The following requirements for admission to the Freshman Class of the Colorado School of Mines are in harmony with the Report of the Commission of the North Central Association of Colleges and Secondary Schools, adopted March 28, 1902, and are in harmony with the recommendation of the University and High School Conference held at Boulder, Colorado, December 12, 1903. They are also in harmony with the Report of the Committee of the American Mathematical Society on Definitions of College Entrance Requirements in Mathematics, appointed at the summer meeting of the American Mathematical Society, September, 1902.

REQUIREMENTS FOR THE FRESHMAN CLASS.

Unit Course. A unit course of study is defined as a course covering a school year of not less than thirty-five weeks, with four or five (preferably five) periods of at least forty-five minutes each per week.

Sixteen Units are required for entrance, of which twelve are specified, and four may be chosen from a list of electives.

SPECIFIED UNITS.

Algebra	1½	units
Plane Geometry	1	unit
Solid Geometry	½	unit
Languages, other than English	2	units
English	3	units
History	2	units
Physics	1	unit
Chemistry	1	unit
Specified Units	12	
Elective Units	4	
Total Units for Entrance	16	

ELECTIVE UNITS.

The four elective units may be selected from the following list: Drawing, Shop Work, Mathematics, Greek, French, German, Spanish, History, English, Science, Psychology. Political Economy.

In allowing credit for drawing and shop work two forty-five minute periods will be regarded as equivalent to one forty-five-minute period of classroom work. Half units are accepted in all studies, except in physics and chemistry, provided that not less than one full unit shall be accepted in language.

METHODS OF ENTRANCE.

(a) By Certificate.

Graduates of Accredited High Schools in the State of Colorado will be admitted without examination upon the presentation of proper credentials from the Principal of their High School, provided that the studies they have sucessfully completed cover the requirements for admission. Blanks for this purpose will be sent on application to the President.

Graduates of Accredited High Schools in other States will be accepted in the same manner as graduates of Accredited High Schools in Colorado.

(b) By Examination.

All other candidates for admission will be required to pass entrance examinations in the specified subjects. These examinations are held in Golden.

For the benefit of students who cannot, on account of the distance, conveniently take the examination at Golden, arrangements will be made so that they may take the examinations under the direction of some responsible person at or near their own homes.

Entrance examinations for the class of 1911 will be held in Golden on Wednesday, Thursday and Friday, August 28, 29 and 30, 1907.

It is the opinion of the Faculty of the Colorado School of Mines that every candidate for the Freshmen class should have taken a thorough course of at least four years in a good High School or in a Manual Training School, and during the last year of his preparation, should have a thorough review of mathematics, or should have received an education equivalent to one of these. The work of the school is so exacting that students who are not well prepared cannot expect to succeed after entrance.

DESCRIPTION OF THE UNITS REQUIRED FOR ENTRANCE.

ENGLISH (3 UNITS).

(a) GRAMMAR. The student should have a sufficient knowledge of English grammar to enable him to point out the syntactical structure of any sentence which he encounters in the prescribed reading. He should also be able to state intelligently the leading grammatical principles when he is called upon to do so.

(b) READING. The books prescribed by the Joint Committee on Uniform Entrance Requirements in English form the basis for this part of the work.

The list is divided into two parts, the first consisting of books to be read with attention to their contents rather than to their form, the second consisting of books to be studied thoroughly and minutely. The lists, thus divided, are as follows:

I. Books prescribed for reading.

For 1907 and 1908: Shakespeare's *The Merchant of Venice* and *Macbeth; The Sir Rodger De Coverly Papers* in The Spectator; Irving's *Life of Goldsmith;* Colebridge's *The Ancient Mariner;* Scott's *Ivanhoe* and *The Lady of the Lake;* Tennyson's *Gareth and Lynette, Lancelot and Elaine,* and *The Passing of Arthur;* Lowell's *The Vision of Sir Launfal;* George Eliot's *Silas Marner.*

II. Books prescribed for study and practice.

For 1907 and 1908: Shakespeare's *Julius Caesar;* Milton's *Lycidas, Comus, L'Allegro and Il Penseroso;* Burke's Speech on *Conciliation with America;* Macaulay's *Essays on Addison and Life of Johnson.*

(c) COMPOSITION. Regular and persistent training in both written and oral composition should be given throughout the entire school course. The topics should be so chosen as to give practice in the four leading types of prose discourse, namely, description, narration, exposition, and argument.

(d) Rhetoric. It is expected that the student will be familiar with the essential principles of rhetoric. The instruction in this subject should include the following particulars: choice of words, structure of sentences and paragraphs, the principles of narration, description, exposition and argument. The teacher should distinguish between those parts of rhetorical theory which are retained in text books merely through the influence of tradition and those which have direct bearing upon the composition work. The former may be safely omitted.

HISTORY (2 Units).

Any two of the following may be offered:

I. Ancient History, with special reference to Greek and Roman History, including also a short introductory study of the more ancient nations and the chief events of the early middle ages, down to the death of Charlemagne (814).

II. Mediaeval and Modern European History, from the death of Charlemagne to the present time.

III. English History.

IV. American History, or American History and Civil Government.

PHYSICS (1 Unit).

Physics. The equivalent of Carhart and Chute's *High School Physics*, or Gage's *Principles of Physics*, including systematic laboratory practice such, for example, at is outlined in Crew and Tatnall's *Labaratory Manual in Physics*.

CHEMISTRY (1 Unit).

General Chemistry. The equivalent of Bradbury's *Elementary Chemistry* or Remsen's *Briefer Course of Inorganic Chemistry*.

MATHEMATICS (3 Units).

I. Algebra. (1½ Units.) The four fundamental operations for rational algebraic expressions; factoring, highest common factor; lowest common multiple; complex fractions; the solution of equations of the first degree containing one or more unknown quantities; radicals, including the extraction of the square root of polynomials and numbers; fractional and negative exponents; quadratic equations and equations containing one or more unknown quantities that can be solved by the methods of quadratic equations; problems depending upon such equations; a review of the essentials should be followed by ratio and proportion, and the binomial theorem for positive integral exponents; the progressions; the elementary treatment of permutations and combinations; the use of four and five place tables of logarithms.

II. PLANE GEOMETRY. (1 Unit.) Completed, including the solution of original exercises and numerical problems.

III. SOLID GEOMETRY. (½ Unit.) Properties of straight lines and planes; of dihedral and polyhedral angles; of projection; of polyhedrons, including prisms; of pyramids and the regular solids; of cylinders, cones and spheres; of spherical triangles, and the measurement of surfaces and solids.

The two units required in languages other than English may be offered in Greek, Latin, French, German or Spanish.

ADMISSION TO ADVANCED STANDING.

GRADUATE STUDENTS. Applicants who are graduates of colleges or technical schools of good standing will be admitted upon the presentation of proper credentials and will be permitted to take any subject taught in connection with the regular courses. Each case will be judged on its own merits, but such applicants will be advised to become candidates for a degree and to complete the regular work of the college. Such graduates will find the advanced courses of the school well adapted to fit them for professional engineering work.

UNDERGRADUATE STUDENTS. Applicants who have partially completed the course in colleges or technical schools of good standing will be admitted upon the presentation of proper credentials. Due credit will be allowed for the successful completion of work which is equivalent to that given in the Colorado School of Mines. Plates of drawings, laboratory note books, and catalogues of the institution attended, should be submitted with applications for advanced standing. The college does not admit special students. All applicants for advanced standing are expected to enroll in one of the regular classes and to become candidates for a degree. Application blanks for advanced standing will be furnished on request to the President.

DEGREES.

The college offers two four-year courses—Mining Engineering and Metallurgical Engineering—leading to the degrees of E. M. (Mining Eingineer) and E. Met. (Metallurgical Engineer).

THESIS AND GRADUATION.

A thesis upon some suitable subject is a prerequisite to the completion of either course. Each senior must submit to the Faculty, not later than November 1st, the subject of his thesis, which must be approved by the Professor concerned. Each thesis must be typewritten or printed on eight and one-half by eleven-inch paper, bound in book form, and submitted not later than May 1st.

No diploma will be delivered until the thesis is handed in, the full requirements of the course of study are satisfied, and all accounts with the college are settled.

DEPARTMENTS OF INSTRUCTION.

TABULAR VIEW.

MINING ENGINEERING.

Freshman Year.

FIRST SEMESTER	Rect. Hrs.	Lab. Hrs.	SECOND SEMESTER	Rect. Hrs.	Lab. Hrs.
College Algebra [p. 78]	5		Analytic Geometry [p. 80]	5	
Trigonometry [p. 79]	3		Elements of Analysis [p. 79]	3	
General Chemistry [p. 71]	5		General Chemistry [p. 71]	5	
Qualitative Analysis			Qualitative Analysis		
Lectures [p. 72]	1		Lectures [p. 72]	1	
Laboratory [p. 72]		9	Laboratory [p. 73]		6
Descriptive Geometry					
Lectures [p. 62]	2		Elementary Machine Design [p. 62]	2	
Drawing [p. 62]		6	Engineering Drawing [p. 63]		9
General Geology [p. 49]	3		Plane Surveying [p. 54]	2	

Plane Surveying: Field-Work [p. 55]. Four weeks in the summer following the regular college year.

Mining Trips to Central City, Idaho Springs, Georgetown and Leyden [p. 82].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

MINING ENIGNEERING—Continued.

Sophomore Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
Differential and Integral Calculus [p. 80]	5		Integral Calculus [p. 80]	3	
			Theoretical Mechanics [p. 81]	2	
General Physics: Mechanics, Heat and Sound [p. 76]	4		General Physics: Electricity, Magnetism and Optics [p. 77]	4	
Physical Laboratory [p. 77]		3	Physical Laboratory [p. 77]		3
Quantitative Analysis: Gravimetric.			Quantitative Analysis Volumetric.		
Lectures [p. 73]	1		Lectures [p. 74]	1	
Laboratory [p. 73]		9	Laboratory [p. 74]		9
Technical Chemistry [p. 75]	2		Technical Chemistry [p. 75]	2	
Crystallography			Determinative Mineralogy		
Lectures [p. 51]	2		Lectures [p. 51]	2	
Laboratory [p. 51]		6	Laboratory [p. 51]		6
Mine Surveying [p. 35]	2		Mine Surveying [p. 36]	2	

Geological Field-Work [p. 50].

Mine Surveying: Field-Work [p. 36]. Four weeks in summer following the regular college year.

Mining Trips to Cripple Creek and the Northern Coal Fields [p. 82].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

MINING ENGINEERING—Continued.

Junior Year.

FIRST SEMESTER	Rect. Hrs.	Lab. Hrs.	SECOND SEMESTER	Rect. Hrs.	Lab. Hrs.
Geology [p. 50]	4		Lithology		
			Lectures [p. 52]	2	
			Laboratory [p. 52]		3
Metallurgy: Fuels, Refractory Materials, Iron and Steel [p. 43]	3		Metallurgy: Lead and Zinc [p. 44]	3	
Mining [p. 37]	3		Mining [p. 37]	3	
Mechanics of Engineering [p. 55]	3		Mechanics of Engineering [p. 57]	3	
Engineering Construction			Mill Construction		
Lectures [57]	2		Lectures [p. 58]	2	
Drawing [57]		3	Drawing [p. 58]		3
Machine Design			Steam Engines and Boilers		
Lectures [p. 63]	2		Lectures [p. 63]	2	
Drawing [p. 63]		6	Drawing [p. 63]		6
Electric Power Transmission			Electric Power Transmission		
Lectures [p. 69]	2		Lectures [p. 69]	2	
			Laboratory [p. 69]		3
Assaying			Testing Laboratory [p. 56]		3
Lectures [p. 44]	1				
Laboratory [p. 44]		9			
Metallurgical Trips, as follows: [p. 83]			Metallurgical Trips, as follows: [p. 83]		
1. Coking Plant			1. Smelting Plant for the study of furnace types		
2. By-product Plant and Gas Producers			2. Iron and Steel Works		
3 Refractory Materials			3. Lead Smelter		
			4. Zinc Smelter.		

Mining Trips to Leadville and Breckenridge [p. 82].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

MINING ENGINEERING—Concluded.

Senior Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
Economic Geology [p. 51]	3		Economic Geology [p. 51]	3	
Ore Dressing			Metallurgy: Gold, Silver, and Copper		
Lectures [p. 45]	4		Lectures [p. 45]	3	
Laboratory [p. 45]		3	Laboratory [p. 47]		3
			Practice [p. 47]		3
Hydraulics [p. 59]	3		Contracts and Specifications [p. 60]	2	
Hyd. and Cement Laboratory [pp. 59, 60]		3			
Compressed Air Machinery [p. 66]	2		Pumping Machinery [p. 67]	2	
Gas Engines [p. 67]	2		Special Mining Machinery [p. 68]	2	
Steam Laboratory [p. 68]		3	Mining Laboratory [p. 39]		3
Power Plant Design			Mine Plant Design		
Lectures [p. 64]	2		Lectures [p. 64]	2	
Drawing [p. 64]		6	Drawing [p. 64]		3
Mining [p. 38]	2		Mining [p. 38]	2	
Mine Ex. and Rep. [p. 38]	2		Economics of Mining [p. 39]	2	
Thesis		3	Thesis		6
Ore Dressing Trips, as follows: [p. 83]			Metallurgical Trips, as follows: [p. 83]		
1. Sampling Works			1. Copper Smelter		
2. Concentrating Plants			2. Gold Milling Plant		
3. Magnetic and Electric Separating Plants			3. Cyanide and Chlorination Mill		

Geology. Advanced Field-Work [p. 50[.

Senior Mining, Metallurgical, and Geological Trip to Colorado Springs, Pueblo, Florence, Canon City, Leadville, and Aspen, Colorado; Park City, Bingham, Newhouse, Frisco, Milford, and Eureka, Utah; Butte and Anaconda, Montana; Black Hills, Deadwood, Lead and Terry, South Dakota [p. 85].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING.

Freshman Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
College Algebra [p. 78]	5		Analytic Geometry [p. 80]	5	
Trigonometry [p. 79]	3		Elements of Analysis [p. 79]	3	
General Chemistry [p. 71]	5		General Chemistry [p. 71]	5	
Qualitative Analysis			Qualitative Analysis		
Lectures [p. 72]	1		Lectures [p. 72]	1	
Laboratory [p. 72]		9	Laboratory [p. 73]		6
Descriptive Geometry					
Lectures [p. 62]	2		Elementary Machine Design [p. 62]	2	
Drawing [p. 62]		6	Engineering Drawing [p. 63]		9
General Geology [p. 49]	3		Plane Surveying [p. 54]	2	

Plane Surveying: Field-Work [p. 55]. Four weeks in the summer following the regular college year.

Mining Trips to Central City, Idaho Springs, Georgetown and Leyden [p. 82].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING—Continued.

Sophomore Year.

First Semester	Rect. Hrs.	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
Differential and Integral Calculus [p. 80]	5		Integral Calculus [p. 80]	3	
			Theoretical Mechanics [p. 81]	2	
General Physics: Mechanics, Heat and Sound [p. 76]	4		General Physics: Electricity, Magnetism, and Optics [p. 77]	4	
Physical Laboratory [p. 77]		3	Physical Laboratory [p. 77]		3
Quantitative Analysis: Gravimetric.			Quantitative Analysis: Volumetric.		
Lectures [p. 73]	1		Lectures [p. 74]	1	
Laboratory [p. 73]		9	Laboratory [p. 74]		9
Technical Chemistry [p. 75]	2		Technical Chemistry [p. 75]	2	
Crystallography			Determinative Mineralogy		
Lectures [p. 51]	2		Lectures [p. 51]	2	
Laboratory [p. 51]		6	Laboratory [p. 51]		6
Mine Surveying [p. 35]	2		Mine Surveying [p. 36]	2	

Geological Field-Work [p. 50].

Mine Surveying: Field-Work [p. 36]. Four weeks in summer following the regular college year.

Mining trips to Cripple Creek and the Northern Coal Fields [p. 82].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING—Continued.

Junior Year.

First Semester	Rect. Hrs	Lab. Hrs.	Second Semester	Rect. Hrs.	Lab. Hrs.
Geology [p. 50]	4		Lithology		
			Lectures [p. 52]	2	
			Laboratory [p. 52]		3
Metallurgy: Fuels, Refractory Materials, Iron and Steel [p. 41]	5		Metallurgy: Lead and Zinc [p. 42]	5	
Mining [p. 37]	3		Mining [p. 37]	3	
Mechanics of Engineering [p. 55]	3		Mechanics of Engineering [p. 57]	3	
Engineering Construction			Mill Construction		
Lectures [p. 57]	2		Lectures [p. 58]	2	
Drawing [p. 57]		3	Drawing [p. 58]		3
Machine Design			Steam Engines and Boilers		
Lectures [p. 65]	1		Lectures [p. 65]	1	
Drawing [p. 65]		3	Drawing [p. 65]		3
Metallurgical Chemistry [p. 75]		6			
Electric Power Transmission			Electric Power Transmission		
Lectures [p. 69]	2		Lectures [p. 69]	2	
Laboratory [p. 69]		3			
Testing Laboratory [p. 65].		3	Assaying		
			Lectures [p. 44]	1	
			Laboratory [p. 44]		9
Metallurgical Trips, as follows: [p. 83]			Metallurgical Trips, as follows: [p. 83]		
1. Coking Plant			1. Smelter Plant for the study of furnace types		
2. By-product Plant and Gas Producers			2. Iron and Steel Works.		
3. Refractory Materials			3. Lead Smelter		
			4. Zinc Smelter		

Mining Trips to Leadville and Breckenridge [p. 82].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING—Concluded.

Senior Year.

FIRST SEMESTER	Rect. Hrs.	Lab. Hrs.	SECOND SEMESTER	Rect. Hrs.	Lab. Hrs.
Economic Geology [p. 51]	3		Economic Geology [p. 50]	3	
Ore Dressing			Metallurgy: Gold, Silver and Copper		
Lectures [p. 45]	4		Lectures [p. 45]	4	
Laboratory [p. 45]		3	Aluminum, Nickel and Metals not elsewhere treated		
			Lectures [p. 46]	3	
Electro-Metallurgy					
Lectures [p. 48]	3		Metallurgical Laboratory [p. 47]		6
Laboratory [p. 48]		3	Metallurgical Practice [p. 47]		3
Power Plant Design			Metallurgical Plant Design		
Lectures [p. 66]	1		Lectures [p. 66]	1	
Drawing [p. 66]		3	Drawing [p. 66]		3
Hydraulics [p. 59]	3		Contracts and Specifications [p. 60]	2	
Compressed Air Machinery [p. 66]	2				
Hyd. and Cement Laboratory [pp. 59, 60]		3			
Steam Laboratory [p. 68]		3			
Mining [p. 38]	2		Mining [p. 38]	2	
Mine Ex. and Rep. [p. 38]	2		Economics of Mining [p. 39]	2	
Thesis		3	Thesis		6
Ore Dressing Trips, as follows: [p. 83]			Metallurgical Trips, as follows: [p. 83]		
1. Sampling Works			1. Copper Smelter		
2. Concentrating Plants			2. Gold Milling Plant		
3. Magnetic and Electric Separating Plants			3. Cyanide and Chlorination Mills		

Geology: Advanced Field-Work [p. 50].

Senior Mining, Metallurgical, and Geological Trip to Colorado Springs, Pueblo, Florence, Canon City, Leadville and Aspen, Colorado; Park City, Bingham, Newhouse, Frisco, Milford and Eureka, Utah; Butte and Anaconda, Montana; Black Hills, Deadwood, Lead, and Terry, South Dakota [p. 85].

The courses are described on the pages indicated after each course.

MINING.

Professor Lewis Emanuel Young.
Assistant Professor Arthur Joseph Hoskin.

The courses in this department are designed to instruct the student in the theory and practice of mineral land and underground surveying; in the application of the sciences to the art of mining; in the principles and applications of the power machinery used in the mineral industry; in the best methods and practices of mining engineers and mine managers.

I MINE SURVEYING. *Lectures.*

This course covers the practical phases of the duties of a U. S. Deputy Mineral Surveyor. Lectures are given upon the legal requirements in locating and patenting mineral ground. Actual and imaginary cases are taken up and the practical work of putting them through the various steps is done. The school is well situated for the field course which supplements the class-room work, the student being given sufficient field experience to render him familiar with the approved methods of surveying lode, placer, and mill-site claims. Complete field notes are taken of problems assigned in the field. These are subsequently put through the office calculations and a complete set of documents prepared for filing in the offices of the U. S. Surveyor General and the Land Office. The theory and practice of determining the meridian and latitude from direct solar observations are included in this course.

Prerequisites: Mechanical Engineering, I. to IV. inclusive.
Mathematics, I. to IV. inclusive.

Geology, I.
Civil Engineering, I. and II.
Texts: Underhill, *Mineral Land Surveying.*
Morrison, *Mining Rights.*

Two hours per week during the first semester of the Sophomore year. (Hoskin.)

II. MINE SURVEYING. *Lectures.*

Attention is given to the practices of underground surveying. Instruction is given in carrying meridians into mines, laying out workings, keeping notes, estimating areas and tonnage, and in the many other duties which are assigned to a mining engineer. Surveying with hand transits and with auxiliary telescopes is taught. The organization of field parties is handled. The determination of dip and strike of ore or coal bodies from drill-hole data, and various methods of locating mine openings for the advantageous opening, development, drainage, haulage, and production of mines are emphasized. The platting of notes and the construction of maps are important subjects taught.

Prerequisite: Course I.

Text: Young, *Mine Surveying Methods.*

Two hours per week during the second semester of the Sophomore year. (Hoskin.)

III. MINE SURVEYING. *Field-Work.*

Each student is given personal instruction and practice in the survey of mines and mining claims. The squads are limited in size in order that each man may learn all the details of the work and appreciate the importance of every phase of the subject. Among the problems assigned are the following: the complete survey of a mining claim; the survey and mapping of a coal or clay mine; the survey and mapping of a metal mine; the complete survey and mapping of a property, including claims, buildings, and mine workings.

Prerequisites: Courses I. and II.

Four weeks in the summer following the regular work of the Sophomore year. (Hoskin.)

IV. MINING.

This course is preliminary to the lectures on mining methods, and includes excavating and breaking ground, prospecting, boring, tunneling, and shaft sinking. The various tools used in excavating, boring, and drilling, the use of explosives in breaking ground, the methods and tools of prospecting and the general and special methods of tunneling and shaft sinking are described in detail in the classroom.

Prerequisites: Courses I, II. and III.
Mathematics, I.-VII., inclusive.
Physics, I.-IV., inclusive.
Geology, I. and II.
Mineralology, I. and II.

Texts: Gillette, *Rock Excavation.*
Stauffer, *Modern Tunnel Practice.*

Three hours per week during the first semester of the Junior year. (Young.)

V. MINING. (Mining Engineering Course only.)

A study of methods used in securing the various mineral products comprises the work of this course. The economical systems developed in coal, copper, iron, and low-grade gold and silver mines are studied in detail. The application of these systems to the various types of deposits is emphasized throughout the lectures.

Prerequisite: Course IV.
Text: Foster, *Ore and Stone Mining.*

Three hours per week during the second semester of the Junior year. (Young.)

VI. MINING. (Metallurgical Course only.)

This course has the same general outline as Course V., but includes also an outline of the general principles included in Courses VIII. and IX.

Prerequisite: Course IV.
Text: Foster, *Ore and Stone Mining.*
Kent, *Mechanical Engineer's Pocketbook.*

Three hours per week during the second semester ot the Junior year. (Young.)

VII. MINING.

In this course the lectures include the support of excavations, mine ventilation, and hoisting. The use of steel, iron, and concrete in mines, the gases and the ventilation of metal mines, and economic hoisting for various conditions receive careful attention.

Prerequisites: Course IV. and either V. or VI.
Mechanical Engineering, either VIII. or XI.

Text: Behr, *Hoisting from Great Depths.*
Sanders, *Mine Timbering.*

Two hours per week during the first semester of the Senior year. (Young.)

VIII. MINING.

In this course the following topics receive attention: systems of transporting the mineral product underground, of carrying it to the mills and railroads, and of draining and unwatering mines. The detailed study of the machinery necessary in these operations is included in Mechanical Engineering, Courses XIII., XV. and XVI.

Finally, the lectures consider safety devices at mines, accidents and their prevention, first aid to the injured, and mine laws and regulations.

Prerequisite: Course VII.

Two hours per week during the second semester of the Senior year. (Young.)

IX. MINE EXAMINATION AND REPORTS.

This course is given in order to train students for general field-work, for the preparation of reports, and for the examination of mining properties. The lectures comprise the presentation and discussion of the different types of reports which a mining engineer may be called upon to make, the facts which should be included in such reports, and the form and style in which they should be written and illustrated. Each student studies various reports of reputable engineers preparatory to submitting any original work.

Reports on prospects and machinery are then prepared by each student. The field methods of the best engineers in the examination of mining properties are then carefully considered. The methods of sampling and estimating ore bodies are studied and each student is required to sample several properties and to make complete reports.

Prerequisites: Course IV. and either V. or VI.
This course is taken in conjunction with Economic Geology.

Text: Rickard, *Ore Sampling*.

Two hours per week during the first semester of the Senior year. (Young.)

X. MINING LABORATORY. (Mining Engineering Course only.

Practical work is given in the testing of pumps, compressors, hoists, rock drills and other special machines used in mining operations and in the mine plant. Special work is given in the operation of electric and compressed-air rock drills under various conditions and in the transmission and reheating of compressed air. Other special features include the sharpening and tempering of steel, the examination of the effect of timber preservatives on timber, and of mine water on cement and concrete for mine structures. Safety appliances are tested under various conditions. A large portion of this work is carried on in the laboratory, while the remainder is conducted out doors, or at mines under actual working conditions.

Prerequisites: Course VII.
Mechanical Engineering, XVII.

Three hours per week during the second semester of the Senior year. (Young, Hoskin.)

XI. ECONOMICS OF MINING.

The lectures of this course consider carefully the organization, operation, and management of mines and especially the economic problems upon which successful management depends. Special lectures are given on the organization of mining companies, mine accounts, mine management, efficiency of mine labor and machinery, the responsibility of emplyoyers, and the ethics of mining enginering. The importance of the financial element is forcefully illustrated by special financial problems, using data from various mining districts.

Prerequisite: Course IX.

Text: Rickard, *Economics of Mining.*

Two hours per week during the second semester of the Senior year. (Young.)

XII. COAL MINING. (Optional.)

A detailed study of mining methods, explosives, mine gases, ventilation, and haulage systems used in coal mining is presented in an optional series of lectures. The organization, operation, and management of typical properties in various districts receive careful attention.

Prerequisite: Course IV.

Two hours per week during the second semester of the Junior or Senior year. (Young, Hoskin.)

XIII. MINING LAW.

This subject is presented in a review of the important laws governing general business and in a special study of laws regulating the mineral industry.

Prerequisite: Course III.

One hour per week during the first semester of the Junior or Senior year.

METALLURGY.

Professor Frank Weiss Traphagen.
Assistant Professor William George Haldane.

The aim of this department is to provide a foundation for practical work in metallurgy. In the lecture room attention is constantly directed to the principles involved in the treatment of ores, especially to chemical reactions and the influence of mass, temperature and other conditions upon these changes. In the laboratory, metallurgical operations are given a critical study, and all the resources of the chemical and of the assay laboratories are drawn upon. The purpose is to equip the college with working size apparatus, illustrating the different types of metallurgical and ore dressing plants, and to have these operated by students, who will check up each operation by careful tests in the laboratories.

I. METALLURGY. *Fuels, Refractory Materials, Furnaces, Iron and Steel.*

(Metallurgical Engineering Course only.)

Fuels. This important subject begins with the study of the theory and principles of combustion, air required for complete combustion, weight and volume of products of combustion, and heat carried away by gases, the work being supplemented by numerous problems. Then the various fuels, solid, liquid and gaseous, natural and prepared, are considered at length. Calorific values are determined from ultimate analyses and compared with results determined by actual experiment. In this connection also the treatment of by-products is taken up. Following this, the various types of furnaces, *i. e.,* blast, reverberatory and muffle used in metallurgical operations are studied, individual furnaces being dealt with in detail under particular metals. The subjects of calorimetry and pyrometry are considered and instruments compared.

Refractory Materials. The source and properties of the various refractories, their manufacture into crucibles and bricks, and methods of testing are dealt with and considered in detail.

Iron and Steel. The development of the metallurgy of iron, and the general application of labor-saving devices, together with the fundamental principles involved in smelting makes it necessary to study these metals first.

The subject is treated in the following order: ores of iron; metallurgical chemistry of iron; blast furnaces; construction; reactions occurring in the operation; hot blast stoves; dust catchers and other accessories; utilization of blast furnace gases; calculation of the furnace charge; wrought iron, production and treatment by direct and indirect methods, including a study of puddling furnaces, forge and mill machinery.

Steel. Acid and basic open hearth, acid and basic Bessemer processes are considered in detail, and the cementation process and manufacture of crucible steel taken up at some length.

Prerequisites: Chemistry, I. to X. inclusive.
Physics, I. to IV. inclusive.
Geology, I. and II.
Mineralogy, I. and II.
Mathematics, I. to VII. inclusive.

References: Sexton, *Fuels and Refractory Materials.*
Greenwood, *Iron and Steel.*

Five hours per week during first semester of the Junior year. (Haldane.)

II. METALLURGY. *Lead and Zinc.*

(Metallurgical Engineering Course only.)

Lead. The metallurgy of lead is considered in the following order: properties of lead and its compounds; ores of lead; sampling and purchasing of lead ores; fluxes and fuel; reverberatory smelting; smelting in the ore hearth; roasting of ores, including the chemistry of the roasting process; blast furnace smelting, including construction; chemistry of the blast furnace; calculation of furnace charges; treatment of products; softening, desilverization, and refining of base bullion; Pattinson process; Parkes process; German and English cupellation.

ZINC. This course comprises a study of the following topics: calcination; roasting and distillation by various methods, including a detailed study of furnace types, direct fired, semi-gas and gas fired; manufacture of retorts; refining of spelter and general cost of production.

Prerequisite: Course I.
References: Hofman, *Metallurgy of Lead.*
Ingalls, *Metallurgy of Zinc.*

Five hours per week during the second semester of the Junior year. (Haldane.)

III. METALLURGY. *Fuels, Refractory Materials, Iron and Steel.*

(Mining Engineering Course only.)

This course is somewhat similar to Course I., the idea being to study only the fundamentals involved in these metallurgical operations, and to give the student a general idea of blast furnace work, and the manufacture of iron and steel.

Prerequisites: Chemistry, I. to X. inclusive.
Physics, I. to IV. inclusive.
Geology, I. and II.
Mineralogy, I. and II.
Mathematics, I. to VII. inclusive.
References: Sexton, *Fuels and Refractory Materials.*
Greenwood, *Iron and Steel.*

Three hours per week during the first semester of the Junior year. (Haldane.)

IV. METALLURGY. *Lead and Zinc.*

(Mining Engineering Course only.)

This course comprises a general study of lead smelting, including ores, sampling, roasting and subsequent treatment in blast furnace and methods of desilverizing and refining. A short lecture course on the metallurgy of zinc is given after the completion of the work in lead.

Prerequisite: Course III.

Reference: Hofman, *Metallurgy of Lead.*

Three hours per week during the second semester of the Junior year. (Haldane.)

V. ASSAYING.

Special attention is directed toward making this course as practical as possible, and, while the importance of accurate work is at no time lost sight of, constant efforts are made to enable the student to handle a large amount of work in as short a time as possible. As nearly as may be the student is put under smelter conditions, and is early made familiar with the system prevailing in the best conducted laboratories, so that in the end he may be able to take his place at once in such a laboratory without undergoing a "breaking-in" course after leaving school.

The work includes all the assays called for in the laboratory of mine, mill or smelter, and the methods, besides those in use so satisfactorily for many years, include also such "short cuts" as have been introduced by assayers having several hundred assays to make daily. The course covers the following: the fusibility of slags of definite composition made up by careful calculation; the fluxing of limestone ores and silicious ores for practice; the running of lead mixtures of known lead, silica and base content to determine the influence of foreign elements; the assay of sulphide and oxide ores of lead; the assay of gold and silver ores of different types by various methods, with a comparison of results; the assay of zinciferous and cupriferous gold and silver ores, of arsenical and antimonial ores; the crucible and scorification assay of mattes and concentrates; the assay of gold, silver and base bullions, of tin and platinum ores and special assays.

Prerequisite: The completed work of the Freshman and Sophomore years, with the exception of mine surveying.

One lecture and nine hours' laboratory work per week during the first semester of the Junior year for the Mining Engineering Course, and one-hour lecture and nine hours' laboratory work during the second semester of the Junior year for the Metallurgical Engineering Course.

(Traphagen, Haldane.)

VI. ORE DRESSING. *Lectures.*

The following represent the main divisions under which this subject is studied; jaw and gyratory breakers; rolls; stamps, gravity, steam and pneumatic; special crushing and fine grinding apparatus; apparatus for sizing, including the various types of screens and classifiers; the actual concentrating machines, including jigs, tables and vanners.

Prerequisites: Courses I. II. and V., or III. IV. and V.

Reference: Richards, *Ore Dressing.*

Four hours per week during the first semester of the Senior year. (Traphagen.)

VII. ORE DRESSING. *Laboratory.*

The work consists of sizing tests of the products of various crushers and operations, concentrating by panning and by various mechanical devices, and comparative studies of the different forms of commercial sizing, classifying and concentrating devices.

Prerequisites: Courses I. II. and V., or III. IV. and V.

Three hours per week during the first semester of the Senior year. (Traphagen, Haldane.)

VIII. METALLURGY. *Gold, Silver and Copper.*

Gold and Silver. This course covers the following: metallurgy of gold and silver, including stamp milling, cyanidation, and chlorination of gold ores; chloridizing roasting, and amalgamation of silver ores; the Russell process and other wet methods for silver; the parting of gold and silver bullion by various commercial methods, with special attention to electrolysis and the sulphuric acid treatment. The various modifications of the cyanide process receive particular attention, especially the treatment of the slimes from zinc precipitation; the Moore filter process; the regeneration of the cyanide; the different methods proposed for precipitating the dissolved gold and the recent attempts to apply the process to silver ores.

COPPER. This subject is considered under the following sub-heads: copper and its ores; distribution of the ores of copper; the sampling and assaying of copper; the chemistry of the calcining process; the preparation of ores for roasting; the roasting of ores in lump form; the roasting of ores in pulverized condition; automatic reverberatory calciners; the smelting of copper; the chemistry of the blast furnace; blast furnaces constructed of brick; blast furnace smelting; pyritic smelting; reverberatory furnaces; the bessemerizing of copper mattes; the electrolytic refining of copper, and the selection of process and arrangement of plant.

Prerequisite: Courses VI. and VII.
References: Peters, *Modern Copper Smelting.*
Park, *Cyanide Process.*
Rickard, *Stamp Milling of Gold Ores.*

Four hours per week during the second semester of the Senior year. (Traphagen.)

IX. METALLURGY. *Aluminum, Nickel and Metals not elsewhere considered.*

(Metallurgical Engineering Course only.)

This course covers the general metallurgy of the metals not previously considered. A study of alloys is made here, and various alloys, especially those of the rarer metals with iron, are given particular attention. The commercial application of electricity to metallurgy is taken up and the different system of electrolytic refining, and also the electrothermic production of metals receive attention.

During this course a series of lectures is given in administration and accounting in metallurgical establishments, in which attention is especially directed to the methods found to give best results.

Prerequisite: Courses VI. and VII.

Three hours per week during the second semester of the Senior year. (Traphagen.)

X. METALLURGICAL LABORATORY.

This covers the comparative treatment of ores by amalgamation, chlorination and cyanidation, with special emphasis given to difficulties of treatment and methods of overcoming such difficulties.

Prerequisites: Courses VI. and VII.

Three hours per week during the second semester of the Senior year. (Traphagen, Haldane.)

XI. METALLURGICAL LABORATORY. (Metallurgical Engineering Course only.)

This course includes optical pyrometers; Junker calorimeter; testing refractory materials for fusibility; influence on refractory power of various elements; thermal gradient; various experiments with iron and steel; microstructure of steel; copper selecting process and chloridizing roasting.

Prerequisites: Courses VI. and VII.

Laboratory Manual: Howe, *Metallurgical Laboratory Notes.*

Three hours per week during the second semester of the Senior year. (Traphagen, Haldane.)

XII. METALLURGICAL PRACTICE.

This course covers the operation of working machines of the various types used in practical metallurgy, including stamp milling, roasting and smelting ores, cyanide and chlorination practice.

Prerequisites: Courses VI. and VII.

The equivalent of three hours per week during the second semester of the Senior year.

(Traphagen, Haldane.)

XIII. ELECTRO-METALLURGY. *Lectures.*

This course is arranged to prepare the student for the practical applications of electro-chemical principles, using as a foundation those principles covered by the course in General Physics. It consists of lectures, illustrated by experiment, recitations, and assigned problems. The subjects are as follows: historical development; the laws of Avogadro and van't Hoff; electrolytic dissociation; electrolytic conduction; potential difference; primary and secondary elements; electro-deposition; fused electrolytes.

Prerequisites: Physics I. to IV. inclusive.

Two lectures and one recitation per week during the first semester of the Senior year. (Wolcott.)

XIV. ELECTRO-METALLURGY. *Laboratory.*

This course is arranged to accompany Course XIII. and consists of the calibration of ammeters, voltmeters, and wattmeters; measurement of electrolytic conductivity; electromotive forces; determination of proper conditions for electro-deposition.

Prerequisites: Physics I. to IV. inclusive.
Course XIII. must be taken in connection with this course.

Three hours per week during the first semester of the Senior year. (Wolcott.)

XV. METALLOGRAPHY. *Lectures and Laboratory Work.*

(Optional.)

This course comprises a study of the constitution and micro-structure of steels and alloys, and their properties as effected by the chemical and mechanical treatment to which they have been subjected.

Prerequisites: Metallurgy, Course I.
Physics, Courses I. to IV. inclusive.
(Haldane.)

GEOLOGY AND MINERALOGY.

PROFESSOR HORACE BUSHNELL PATTON.
INSTRUCTOR G. MONTAGUE BUTLER.
INSTRUCTOR CHARLES EDWARD SMITH.

The School is very fortunately situated for the geologist. The surrounding formations not only present the strikingly clear features so characteristic of the West, but occur in great profusion and variety. In addition certain features peculiar to this particular location afford sufficiently complicated problems to be of great value to the student of geology. It is possible, therefore, without going more than a mile or two from the school to illustrate very effectively most geological problems; and field geology can be carried on at the same time with class instruction.

The subjects presented are classified under three heads: A, Geology; B, Mineralogy; C, Lithology.

A. GEOLOGY.

I. GENERAL GEOLOGY.

This course is intended as a preliminary one and is a preparation for the more advanced course given in the Junior year. It discusses general geological principles more particularly in connection with dynamical, structural, and physiographic geology. The course is essentially a lecture course based on a text book.

Prerequisite: Entrance requirements.

Text: Chamberlin and Salisbury, *Geology (Vol. I., Processes and Their Results).*

Three hours per week during the first semester of the Freshman year. (Smith.)

II. GEOLOGICAL FIELD-WORK.

In connection with Course I. a certain amount of field work is required. It is intended to illustrate the general principles of geology, including training in the recognition of the simpler types of rocks and in the observation of their attitude and structure; in the use of simple field instruments; in note taking and making of reports; in mapping and section drawing. The work is continued in the sopohomore year, when particular problems are assigned to individual students or squads. These problems are mainly structural in character, such as the tracing and mapping of veins and contacts; the location and study of faults; the mapping and reporting upon clay pits.

Prerequisite: Course I.

Eight afternoons, or their equivalent, during the first semester of the Sophomore year.

(Smith, Patton, Butler.)

III. GEOLOGY.

This course is a continuation of Course I., and is given by means of lectures and text-book work. It deals mainly with historical and stratigraphic geology, with special reference to American areas.

Prerequisites: Mineralogy, I. and II.
Geology, I.

Four hours per week during the first semester of the Junior year. (Butler.

IV. ADVANCED GEOLOGICAL FIELD-WORK.

This course embraces mainly field work in areal geology. Each student is assigned a particular section which he is to study, map, and report upon. This throws the student upon his own resources and gives him not only further practice in geological observation, but also the necessary training for preparing reports based upon his own observations.

Prerequisites: Courses I. II. and III.

Four full days in the field, or their equivalent, during the first semester of the Senior year.

(Smith, Patton, Butler.)

VI. ECONOMIC GEOLOGY.

This course discusses the matter of ore deposits, their nature, occurrence and origin, especially the ores carrying the precious metals. Attention is also given to other natural products of economic value, such as coal, petroleum, and building stones.

Prerequisites: Chemistry I. to VI. inclusive.
Mineralogy I. and II.
Lithology I.

Three hours per week throughout the Senior year.

(Patton.)

B. MINERALOGY.

I. CRYSTALLOGRAPHY.

This course is treated as an essential part of the general work in mineralogy, and only such portion of the subject is especially emphasized as is of practical value in the determination and the proper understanding of minerals. A very thorough drill, however, is given in the more practical portions of the subject. The course is presented through lectures, text books, and practical laboratory work; also by individual quizzes. In connection with the laboratory work each student is required to become thoroughly familiar with crystal forms and combinations such as are found on the usual wooden crystal models, and to determine with the aid of a pocket lens and contact gonimeter the crystal forms of three hundred crystals.

Prerequisites: Chemistry I.-VI. inclusive.

Text: Patton, *Lecture Notes on Crystallography.*

Lecture two hours, laboratory six hours per week, during ten weeks of the first semester of the Sophomore year.

(Patton, Butler, Smith.)

II. DETERMINATIVE MINERALOGY.

This course begins about the middle of November with a five-weeks' drill in the methods of blowpipe analysis, with a view to preparing the student for the practical determination of minerals. This is followed by determinative mineralogy proper, which continues until the close of the second semester of the Sophomore year.

In this course about two hundred fifty of the most important mineral species are presented by lectures, in which special emphasis is laid on the recognition of minerals by means of their physical properties and crystal forms. The object constantly kept in mind is not the training that will enable one to determine any mineral whatever, but rather to recognize at sight such minerals as are likely to be met with in connection with mining operations. This is what the average mining engineer is expected to do. With this object in view, as thorough a drill as the time will allow is given in the actual handling and determining of minerals in the laboratory. In this work each student is expected to handle, determine, and be examined on, approximately two thousand five hundred individual specimens.

Prerequisite: Mineralogy, I.

Text: Moses and Parsons, *Mineralogy, Crystallography and Blowpipe Analysis.*

Lectures two hours, laboratory six hours per week, from the middle of November to the close of the second semester of the Sophomore year.

(Patton, Butler, Smith.)

C. LITHOLOGY.

I. LITHOLOGY.

This is a lecture course supplemented by laboratory work. The object is to present all the more commonly occurring rocks in such a way as to render their identification at sight reasonably accurate. The methods pursued are purely those applicable to the hand specimen without the aid of microscopic sections. The collection of the school is especially rich in those rocks that are usually encountered in mining operations in Colorado and adjacent states. Special emphasis, therefore, is laid upon such rocks and upon their various alteration forms.

Prerequisites: Geology, I. II. and III.
Mineralogy, I. and II.

Text: Kemp, *Handbook of Rocks.*

Lecture two hours, laboratory three hours per week, during the second semester of the Junior year.

(Patton, Butler, Smith.)

II. PETROGRAPHY. (Optional.)

This course takes up the optical properties of minerals and follows up the course on lithology by a study of thin sections of rocks by means of the microscope. It is an optional course, to be limited to such students as are specially qualified to take it.

Prerequisites: Mineralogy, I. and II.
Lithology, I.

Lectures and laboratory work to be arranged.

(Patton.)

CIVIL ENGINEERING.

PROFESSOR WILLIAM FRANKLIN ALLISON.
ASSISTANT PROFESSOR WILLLIAM JONATHAN HAZARD.

The aim of this department is to prepare the student to make all the necessary surveys, calculations, and estimates that the mining and metallurgical engineer may be called upon to make, and at the same time to give him such a knowledge of plane surveying as will enable him to undertake any of the work that the surveyor is called upon to do in land, city, topographical, and railroad surveying. The practical is constantly emphasized, and to that end the work assigned to the student is such work as the surveyor meets in practice. The many advantages offered by the mineral, coal and clay mines in actual operation near Golden, together with the interest taken by the operators of these mines, as is shown by their willingness to give classes right of way for practicing surveying, make the college particularly strong in this kind of work. This department also aims to perfect the engineering student in the theoretical discussion of strains and stresses in mechanisms and structures. It teaches the practical application of the theory in the design of machinery in general and of structures in detail. The course in hydraulics and hydraulic motors develops the theoretical, empirical, and practical sides of hydraulics. Thorough laboratory practice is required in connection with the courses, thus providing concrete applications of elementary and involved principles.

I. PLANE SURVEYING.

Instruction is given by lectures and recitations in the theory, construction, use and care of the surveyor's instruments of precision. The work includes the adjustment of instruments; the theory and use of the barometer, planimeter and plane-table; the principles of land, city, topographical, and railroad surveying, and the determination of the true meridian by means of various solar attachments and by direct observation of the sun and of circumpolar stars.

Prerequisites: Mathematics, Courses I. and II.
Mechanical Engineering, Courses I. and II.

Text: Raymond, *Plane Surveying.*

Two hours per week during the second semester of the Freshman year. (Allison.)

II. SURVEYING. *Field Work.*

This course includes adjusting instruments; traverse surveying; observations and calculations for determining distances, areas and volumes; observations for the location of the meridian; the ordinary problems in city surveying; stadia work in connection with a topographical survey of some section near Golden. A short railway line is located, cross-sectioned, and the earthwork computed.

Prerequisite: Course I.

Texts: Pence and Ketchum, *Surveying Manual.*
Searles, *Field Engineering.*

This course occupies four full weeks following the completion of the Freshman year. (Allison.)

III. MECHANICS OF ENGINEERING.

The course consists of the theoretical study of mechanisms and materials, embracing statics of a material point and of rigid bodies; centers of gravity or centroids; chains, cords and cables; moments of inertia and radii of gyration of plane figures; stresses and strains; tension, shearing, compression; torsion, flexure; combined torsion and flexure; elastic curves; safe loads; oblique forces; long columns and continuous beams. Much emphasis is placed upon the rapid and accurate application of principles to commercial forms of materials and mechanisms. The course also introduces the student to the fundamental ideas of the motions of bodies, initially treating the dynamics of a material point with extensions of the theory to finite bodies. The fundamental differential equations of rectilinear motion are developed, and practical applications are found in the case of falling bodies, upward throw, and uniformly and variably accelerated bodies. Newton's laws are the basis of these latter items and also of the hypothetical "Engineers' Mass." The principles of harmonic motion are derived and discussed fully in connection with the Scotch Yoke, and the steam engine receives its preliminary introduction to the student. Colliding bodies receive attention in the discussion of the principles of impact.

Prerequisites: Mathematics, Courses I. to VII.
Mechanical Engineering, Courses I. to IV.

Texts: Church, *Mechanics of Engineering.*
Church, *Notes and Examples in Mechanics.*
Problem Sheets.
Cambria Steel.

Three hours per week during the first semester of the Junior year. (Allison.)

IV. TESTING LABORATORY.

This course acquaints the student with the difficulties attending the practical application of theory. It emphasizes systematic and logical presentation, shows the importance of small details, secures data for future use, and provides a criterion as to the value of a student in his profession. Tests are made to determine the strength and stiffness of building materials such as cast-iron, wrought-iron, steel, and wood in tension, compression, shearing, and flexure. Stone and brick are examined for strength, absorption, disintegration, and other qualities which decide their economic values. The correct dimensioning and surfacing of specimens also forms an integral part of the course. Steel forms are submitted to the students for the determination of the centers of gravity and the moments of inertia. Written reports covering the apparatus, procedure, data, computation, results, and conclusions are required from each student.

Prerequisite: This course must be taken in conjunction with Course III.

Three hours per week throughout the Junior year.
(Hazard.)

V. MECHANICS OF ENGINEERING.

This course is an extension of Course III. Virtual velocities introduce the first elements of the principles of work and energy and serve as a basis of discussion in the treatment of the curvilinear motion of a material point which follows. Under this latter head the general equations and principles of curvilinear motion are derived and then applied to simple and cycloidal pendulums, to planetary motion, to a projectile in vacuo, to a body on smooth curved guide, and to absolute and relative velocities. For use in the motion of rigid bodies, the moments of inertia of the common geometrical solids are derived, after which the dynamics of rigid bodies are studied. The conceptions of equivalent and of equilibrating systems are involved in the study of rotating bodies, compound pendulums, rudimentary engines, fly-wheels, eccentric pulleys, rolling bodies, parallel rod of locomotive, hoisting in mines, and the like. Following these, the principles of work and energy are derived and emphasized in the study of problems involving fly-wheels and stationary engines, friction dynamometers, belting, trains and locomotives, and hoisting apparatus. The course is concluded by a short reading in the graphics of mechanisms.

Prerequisites: Courses III. and IV.
Mechanical Engineering V. or IX.

Texts: Church, *Mechanics of Engineering.*
Church, *Notes and Examples in Mechanics.*
Problem Sheets.
Cambria Steel.

Three hours per week during the second semester of the Junior year. (Allison.)

VI. ENGINEERING CONSTRUCTION.

In this course instruction is given in graphical analysis of the stresses in the more elementary forms of framed structures and a comparison is made with the algebraic solutions of the same problems. The student is required to make a close study of the force triangle, pole, ray, equilibrium polygon, resultant of forces, pier reaction, vertical dimensions of equilibrium polygons, together with the application to simple beams, center of gravity, moment of inertia, articulated cranes, trusses, gallows frames and head frames. The course also embraces the computation of loads to be borne by frames, from the weights of parts and the elements involved. The student becomes familiar with the definitions of parts, such as housing, notching, mortise and tenon, dovetailing, lag-screws, dowels and lugs, and, from accepted unit stresses, the student is led to design joints, splices, deepened beams, trussed beams, gallows frames and head frames from wood. A brief study is made of the ordinary timbers used in construction and the best modern methods of protecting them from the action of the elements and wood destroying insects. Some attention is given to riveted and pin-connected trusses of steel.

Prerequisites: Mathematics, Courses I. to VII.
Mechanical Engineering, Courses I. to IV.

Texts: Ketchum. *Steel Mill Buildings.*
Miscellaneous references.
Lecture notes.

Lectures and recitations two hours per week and drafting three hours per week during the first semester of the Junior year. (Allison.)

VII. MILL CONSTRUCTION.

This course is a study of the theoretical and practical design of wooden and steel mill buildings and the uses of masonry in connection therewith. The general forms of such buildings are discussed and elementary ideas of ventilation, lighting, coverings, and the like are obtained. A wooden roof truss of accepted pattern is analyzed graphically and a detailed design, including roofing, rafters, purlins, upper and lower chords, struts, tie-rods, splices, corbels, anchorage, laterals, and miscellaneous joints, is completed.

Steel mill buildings are thoroughly discussed, an analysis of all stresses involved is obtained and a complete design is required from each student. A suitable amount of time is given to the study of the materials used in masonry construction, such as brick, stone, lime, cement, plain and re-enforced concrete. A design of a dam, retaining wall, or foundation, is completed, together with estimates of quantities and cost.

Prerequisites: Courses III. IV. V. and VI.

Texts: Ketchum, *Steel Mill Buildings.*
Cambria Steel.
Miscellaneous references.
Lecture Notes.

Lectures and recitations two hours per week and design three hours per week during the second semester of the Junior year. (Allison.)

VIII. CEMENT LABORATORY.

The intent of this course is to so familiarize the student with the properties of cement that he may not hesitate to utilize this material in his professional work. The laboratory also provides extensive opportunities for research and investigation. The course covers tests for natural and Portland cement and cement mortars for tensile, crushing, and transverse strength, adhesion, soundness, fineness, setting, freezing, and effect of chemicals. The course also embraces the mixing of cement into mortar and concrete.

Prerequisites: Courses III. and IV.

Texts: *Seminary assignments to various works.*

Three hours per week during the first semester of the Senior year, in connection with Course X. (Hazard.)

IX. HYDRAULICS AND HYDRAULIC MOTORS.

The course deals with the theory and practical application of the properties of fluids at rest and in motion, embracing hydrostatic pressure, manometers, strength of pipes, pressures in tanks and against walls and dams; immersion and flotation; steady flow of liquids through pipes and orifices and over weirs; fluid friction and losses of head; time of emptying vessels; steady flow of water in open channels and Kutter's formula; impulse and resistance of fluids; pumps and rams; the Pelton water motor; overshot, breast and undershot water-wheels; back water; theorem for flow in a revolving pipe; turbine and reaction wheels; theory of turbine testing.

Prerequisites: Courses III. IV. V. and VI.

Texts: Church, *Mechanics of Engineering.*
Church, *Hydraulic Motors.*

Three hours per week during the first semester of the Senior year. (Allison.)

X. HYDRAULIC LABORATORY.

Measurements are made of the flow over weirs, through orifices, and through flumes and ditches. The determination of the approximate law of flow in pipes also forms part of the course. Water-wheels are tested and the efficiency of the hydraulic ram under various conditions is determined.

Arrangements have been made by which this department has the use of the city water supply for experimental work with wheels and nozzles. This will make available a head of about twelve hundred feet. With the supply available for a few hours' work, tests may be made on wheels developing over three hundred horse-power.

Prerequisite: This course can be taken only in conjunction with Course IX.

Three hours per week throughout the first semester of the Senior year, in connection with Course VIII.

(Hazard.)

XI. CONTRACTS AND SPECIFICATIONS.

This course is given to familiarize the student with the forms and the legality of contracts, together with the parties having power to make them and to carry them out. The student also becomes acquainted with the common forms of specifications. A synopsis of the law of contracts is first taken up, dealing with competency; the agreement and its legality; the consideration; sealed and parole contracts; assignment; construction; subsequent changes, discharge and remedies for breach of contract. This is followed by a study of engineering specifications and accompanying documents dwelling upon advertising, instructions to bidders, forms of proposals, general and specific clauses in engineering specifications, together with illustrative examples of complete contracts and specifications. Lectures by members of the legal and technical professions will also assist the student in more fully understanding the subject.

This course is intended only for regular Seniors but others may take it by special permission.

Text: Johnson, *Engineering Contracts and Specifications.*

Two hours per week during the second semester of the Senior year. (Allison.)

MECHANICAL ENGINEERING.

Assistant Professor Frank Howard Cronin.

I. DESCRIPTIVE GEOMETRY.

This course begins with the fundamental problems on point, line, and plane and continues through shades and shadows, sections and projections of solids, isometric and horizontal projections, curved surfaces, intersections of solids and surfaces, and perspective.

Prerequisites: Entrance requirements.

Text: Low, *Descriptive Geometry, Parts I. and II.*

Two hours per week during the first semester of the Freshman year. (Burger, A. C. Smith.)

II. DESCRIPTIVE GEOMETRY DRAWING.

This work in the drawing room starts at the same time as the recitation work and is a direct application of the problems taken up in the recitation room.

Prerequisites: Entrance requirements.

Text: Low, *Descriptive Geometry, Parts I. and II.*

Six hours per week during the first semester of the Freshman year. (Cronin, A. C. Smith.)

III. ELEMENTARY MACHINE DESIGN.

Lectures and recitations on the principles underlying the design of machine parts and modes of motion. Special attention is paid to lettering and dimensioning of drawings.

Prerequisites: Courses I. and II.

Text: Reid, *Mechanical Drawing and Elementary Machine Design.*

Two hours per week during the second semester of the Freshman year. (Cronin.)

IV. ENGINEERING DRAWING.

The work in the drafting room is a direct application of the problems taken up in the lecture room. The aim of this course is to teach the proper way of making drawings for use in practice, good shop systems being adopted. Designs for screws, nuts and bolts are first taken up; then follow keys, cotters and gibs; rivets and riveted joints; shaft couplings and hangers; pipes and pipe couplings.

Prerequisites: Courses I. and II.

Text: Reid, *Mechanical Drawing and Elementary Machine Design.*

Nine hours per week during the second semester of the Freshman year. (Cronin, A. C. Smith.)

MINING ENGINEERING COURSES.

V. MACHINE DESIGN AND DRAWING.

Lectures and recitations on the different ways of transmitting power, including a close study of the best methods of determining what is required. Special attention is paid to the forces and stresses involved; all proportions of parts are analyzed and tested by the use of the mechanics of materials.

The work in the drafting room includes the design and layout of shafting; belt, cotton and manilla rope and wire rope drives; spur, bevel and friction gear drives, and variable speed devices.

Prerequisites: Courses I. to IV. inclusive.

This course must be taken in conjunction with or subsequent to Mechanics of Engineering.

Text: Low and Bevis, *A Manual of Machine Design and Drawing.*

Two hours lectures and six hours drawing per week during the first semester of the Junior year. (Cronin.)

VI. STEAM ENGINES AND BOILERS.

This course is especially designed for the needs of the mining engineering students. It includes a thorough investigation into the relative merits of the various types of steam engines and boilers, together with the accessory apparatus, such as mechanical stokers, stacks, coal and ash-handling machinery, fuel economizers and feed-water heaters: condensers and cooling towers, piping, steam separators, traps, and lubrication.

The drawing room work includes the design of foundations, return tubular boiler and setting, self-supporting and guyed stacks, steam and water piping.

Prerequisite: Course V.

Text: Hutton, *Mechanical Engineering of Power Plants.*

Two hours lectures and six hours drawing during the second semester of the Junior year. (Cronin.)

VII. POWER PLANT DESIGN.

This course includes the assemblage of the apparatus treated specifically under Course VI. Special attention is paid to the selection of the best type and size of apparatus and arrangement according to the best practice. A design of a certain size power plant is drawn up, showing the principal apparatus installed. This includes a layout to scale of foundations, boilers, flues, and stack; pumps and feed-water heaters; engines and electrical machinery; steam and water piping; coal and ash-handling machinery.

Prerequisite: Course VI.

Text: Hutton, *Mechanical Engineering of Power Plants.*

Two hours lectures and six hours drawing per week during the first semester of the Senior year. (Cronin.)

VIII. MINE PLANT DESIGN.

Independent of thesis work, each student is assigned problems in design, organization, and installation of plants. Original design is encouraged but must be subordinate to the practice of leading machinery houses. All results are submitted according to approved business methods. Before attempting problems, students are required to familiarize themselves with equipment installed or in operation under similar conditions. Final results include working drawings, bills of materials, estimates, specifications, contracts, a technical description of the plant, and a scheme for possible enlargement.

Prerequisite: Course VII.

One hour lecture and three hours drawing per week during the second semester of the Senior year.

(Young, Hoskin, Cronin, Allison.)

METALLURGICAL ENGINEERING COURSES.

IX. MACHINE DESIGN AND DRAWING.

This course for the metallurgical students has the same general outline as that for the mining students, but is more of an empirical nature. The work covers the study of engineering appliances rather than their design.

The work in the drafting room consists of laying-out shafting; belt, cotton rope, and manilla rope, and wire rope drives; spur, bevel and friction gear drives and variable speed devices. The work is, as far as possible, the application of apparatus to metallurgical operations.

Prerequisites: Courses I. to IV. inclusive.

This course must be taken in conjunction with or subsequent to Mechanics of Engineering.

Text: Low and Bevis, *A Manual of Machine Drawing and Design.*

One hour lecture and three hours drawing per week during the first semester of the Junior year. (Cronin.)

X. STEAM ENGINES AND BOILERS.

This course is especially devised to meet the needs of the metallurgical students. The work is of the same nature as that for the mining students.

The work in the drafting room consists of a design and setting for a return tubular boiler; design of furnaces, stacks and flues; methods of staying brickwork.

Prerequisite: Course IX.

Text: Hutton, *Mechanical Engineering of Power Plants.*

One hour lecture and three hours drawing per week during the second semester of the Junior year.

(Cronin.)

XI. POWER PLANT DESIGN.

This course consists of the design of a power plant; an assemblage of the more important apparatus taken up in Course X.

The drafting room work consists of laying out to scale foundations for machinery; boilers, flues and stacks; pumps and feed-water heaters; engines and electrical machinery; steam and water piping; coal and ash-handling machinery.

Prerequisite: Course X.

Text: Hutton, *Mechanical Engineering of Power Plants.*

One hour lecture and three hours drawing per week during the first semester of the Senior year.

(Cronin.)

XII. METALLURGICAL PLANT DESIGN.

The object of this course is to more thoroughly acquaint the student with the design and operation of apparatus and equipment for metallurgical plants than can be obtained from a lecture course alone. The lecture work includes a close study of the salient mechanical points of the design; the drafting room work includes the design and layout of reverberatory, roasting and smelting furnaces; concentrators and dryers; cyanide and chlorination mills. Before attempting problems, students are required to familiarize themselves with equipment installed and in operation under actual conditions. Working drawings, including bills of material, are submitted according to the most approved business methods.

Prerequisite: Course XI.

Text: *Trade Catalogues and Hand Books.*

Lecture one hour and drawing three hours per week during the second semester of the Senior year.

(Cronin, Traphagen, Haldane.)

XIII. COMPRESSED AIR MACHINERY.

A study of the machinery effecting the compression of air and the various machines using compressed air comprises the work of this course. The theory of the compression and expansion of air is carefully considered before beginning the study of the air compressor. Single and multiple stage compressors, commonly used in mining districts, are then explained. Cooling and reheating, drying of air, and transmission of power by compressed air, together with a general resumé of the efficiency of compressed air, complete the first section of the course. Compressed air machinery, commonly used about mines, is then carefully studied. Among the types especially considered are hoists, pumps, locomotives, rock drills and coal cutters. The course concludes with a study of the efficiency, management, and methods of testing such machines.

Prerequisites: Either Course VI. or X.

Text: Richards, *Compressed Air.*

Two hours per week during the first semester of the Senior year. (Hoskin.)

XIV. GAS ENGINES.

This course comprises a study of the theory, construction, operation and efficiency of internal combustion engines. Special attention is given to the types of engines adapted to service in the arid and mountain regions and to underground conditions. The course concludes with a careful consideration of the management and testing of these machines.

Prerequisites: Either Course VI. or X.

Text: Lucke, *Gas Engine Design.*

Two hours per week during the first semester of the Senior year. (Hoskin.)

XV. PUMPING MACHINERY.

This course considers the pumping machinery adapted to mines and mills. It includes a careful study of the important types of steam, electric and compressed air pumps; of rotary and centrifugal machines; of valves and pump parts; and of the duty of pumps.

Prerequisites: Either Course VI. or X.

Text: *Trade Catalogues.*

Two hours per week during the second semester of the Senior year. (Hoskin.)

XVI. SPECIAL MINING MACHINERY.

This lecture course comprises a review of the various types of mining machinery already studied in Courses XIII. XIV. and XV, and a study of other machinery not included in preceding courses. Notable among such equipment are conveyors, dredges, ventilating machinery, tramways, electric hoists, loaders, and automatic devices for handling mine products. Models and working size examples of these machines are examined and explained, the machinery laboratory being equipped with actual machines such as are upon the market for the mining trade. Experiments are conducted to make the students familiar with the use of these machines. Manufacturers' catalogues are distributed, and the usual transactions and specifications involved in purchasing machinery are explained.

Prerequisites: Either Course VI. or X.

Text: *Trade Catalogues.*

Two hours per week during the second semester of the Senior year. (Hoskin.)

XVII. STEAM LABORATORY.

In this course, practical work is given in determining the power and efficiency of boilers, engines, and steam turbines. The values of various fuels, in boiler practice, are ascertained by systematic tests, and the student is required to find the economy possible in the use of feed water heaters, reheaters and cooling towers. Indicator cards are taken from engines and under different conditions of load, special attention being paid to the thermodynamics of steam. The testing of pressure gages and the setting of engine valve gears are among the experiments conducted.

Prerequisite: Either Course VI. or X.

Three hours per week during the first semester of the Senior year. (Hoskin.)

ELECTRICAL ENGINEERING.

ASSISTANT PROFESSOR WILLIAM JONATHAN HAZARD.

I. ELECTRIC POWER TRANSMISSION.

The object of this course is to familiarize the student with the practical applications of electricity and to enable him to make intelligent selection of apparatus found in the market which will best fulfil his requirements. It deals with the generation, measurement, transmission, and utilization of direct and alternating currents. The various systems of lighting are discussed. Direct and alternating current motors with their auxiliaries are studied in some detail to enable the user to adapt machines to altered conditions of use, where such changes are possible. Many problems are given to fix in the mind the principles studied. The course is given by text-book and lectures, supplemented by laboratory work and visits to various power plants.

Prerequisites: Physics I. to IV. inclusive.

Text: Franklin and Esty, *Elements of Electrical Engineering.*

Two hours per week throughout the Junior year.

(Hazard.)

II. ELECTRICAL LABORATORY.

This is the laboratory course accompanying Course I. It includes the calibration of voltmeters, ammeters and wattmeters, the measurement of the resistance of generators and motors, the determination of the range and capacity of rheostats for voltage and speed control, finding the saturation and characteristic curves and efficiencies of machines, determining the regulation and power factor of motors and the character of speed control by different systems.

Prerequisites: Physics I. to IV. inclusive.

Three hours per week during the first semester of the Junior year for the Metallurgical Engineering Course, and three hours per week during the second semester of the Junior year for the Mining Engineering Course. Also, six hours per week for the class during the Senior trip.

(Hazard.)

CHEMISTRY.

Professor Herman Fleck.
Instructor Charles Darwin Test.
Instructor John Christian Bailar.

The courses in chemistry are arranged especially for the needs of the mining and metallurgical engineer. The demands made upon chemistry by these branches of engineering require a broad knowledge of inorganic chemistry, of the theories underlying the science, and a close acquaintance with the properties of the elements, their reactions, detection, and separation.

I. GENERAL CHEMISTRY.

The course begins with a historical sketch of the development of the science of chemistry up to the atomic era. Thereafter history is introduced only as occasion demands. While the course rests on a structure of inorganic chemistry, the development and application of modern theories and of organic chemistry are taught as the work advances through the non-metallic elements during the first semester. Simultaneously a closer inspection of these elements is offered in the laboratory.

Prerequisites: Entrance requirements.

Text: Richter, *Inorganic Chemistry.*

Four hours lectures and one hour recitation per week during the first semester of the Freshman year.

(Fleck.)

II. GENERAL CHEMISTRY.

The second semester proceeds with the metals, which follow in the order of their periodicity, the periodic law having been previously expounded. Elementary metallurgy is introduced as the commercially important metals are considered.

Prerequisites: Entrance requirements.

Text: Richter, *Inorganic Chemistry.*

Four hours lectures and one hour recitation per week during the second semester of the Freshman year. (Fleck.)

III. QUALITATIVE ANALYSIS. *Lectures.*

The course treats of the theory of qualitative analysis and of special methods of identification. The law of Mass Action and the Dissociation Theory are drawn upon for the former and standard works and current literature supply the latter.

Prerequisites: Entrance requirements.

Texts: Medicus, *Qualitative Analysis.*
Smith and Keller, *Experiments.*

Two hours per week during the first semester of the Freshman year. (Fleck, Bailar, Test.)

IV. QUALITATIVE ANALYSIS. *Laboratory.*

The course begins with a short review, in the laboratory, of the non-metals. The student, equipped with a working knowledge of experimental manipulation, undertakes the study of the reactions of the bases and their separation.

Prerequisites: Entrance requirements.

Texts: Medicus, *Qualitative Analysis.*
Smith and Keller, *Experiments.*

Nine hours per week during the first semester of the Freshman year. (Fleck, Bailar, Test.)

V. QUALITATIVE ANALYSIS. *Lectures.*

The course proceeds with the study of the metals, their detection and separation by special methods and dwells particularly upon correct interpretation of the reactions involved and precautions necessary to obtain correct results. Details concerning the treatment of compounds, including minerals and mixtures, are entered into.

Prerequisites: Entrance requirements.

Text: Medicus, *Qualitative Analysis.*

Two hours per week during the second semester of the Freshman year. (Fleck, Bailar, Test.)

VI. QUALITATIVE ANALYSIS. *Laboratory.*

The practice of manipulation and study of the bases, their detection and separation are continued. The acids are then taken up and treated after the manner of the preceding. More complex substances are given for analysis and the decomposition and solution, and examination of refractory substances follow.

Prerequisites: Entrance requirements.

Text: Medicus, *Qualitative Analysis.*

Six hours per week during the second semester of the Freshman year. (Fleck, Bailar, Test.)

VII. QUANTITATIVE ANALYSIS.—*Lectures.*

(GRAVIMETRIC.)

The work of the first semester begins with a consideration of the theories of solution, electrolytic dissociation, and mass action as applied to analytical chemistry. The determination and separation of the elements and important radicals are considered in detail. The aim of the course is to study the general principles and methods of separation as used in quantitative analysis.

Prerequisites: Courses I. to VI. inclusive.

Text: Cairns, *Quantitative Analysis.*

One hour per week during the first semester of the Sophomore year. (Test.)

VIII. QUANTITATIVE ANALYSIS.—*Laboratory.*

(GRAVIMETRIC.)

The work begins with the analysis of simple salts. By this means the practice of manipulation and the observance of necessary precautions are learned. Gradually the analyses of substances of more complex nature are introduced.

Prerequisites: Courses I. to VI. inclusive.

Text: Cairns, *Quantitative Analysis.*

Nine hours per week during the first semester of the Sophomore year. (Fleck, Baila., Test.)

IX. QUANTITATIVE ANALYSIS.—*Lectures.*

(VOLUMETRIC.)

This course consists of a study of volumetric methods of analysis. First a consideration of the theory of indicators and methods of acidimetry and alkalimetry is taken up. Later the methods of the determination of the more important substances are studied, special attention being given to the principles of the methods used in smelter practice.

Prerequisites: Courses I. to VI. inclusive.

Texts: Bailar, *Laboratory Notes.*
Cairns, *Quantitative Analysis.*

One hour per week during the second semester of the Sophomore year. (Test.)

X. QUANTITATIVE ANALYSIS.—*Laboratory.*

(VOLUMETRIC.)

This course undertakes instruction in the use of standard solutions and a study of the reactions involved. In due time the methods commonly used in metallurgical industries are introduced. A knowledge of the preparation of standard solutions and their use is acquired by a course in acidimetry and alkalimetry. The preparation of standard solutions and their use in the wet assays of ores and products containing iron, manganese, lead, zinc, copper, and other metals are practiced.

Prerequisites: Courses I. to VI. inclusive.

Text: Bailar, *Laboratory Notes.*

Nine hours per week during the second semester of the Sophomore year. (Fleck, Bailar, Test.)

XI. TECHNICAL CHEMISTRY.

A broader acquaintance with industrial methods of chemistry, especially in the inorganic field, is an essential in the education of the engineer. The course is intended to supply this by illustrated lectures on chemistry applied to the arts and the apparatus used therein. Among the subjects considered are: acids, alkalis, chlorine and its products, potassium cyanide, explosives, bricks and other clay products.

Prerequisites: Courses I. and II.

Two hours per week during the first semester of the Sophomore year. (Bailar.)

XII. TECHNICAL CHEMISTRY.

The second semester continues with the following subjects; coal and its products, petroleum, cements, white lead, zinc-lead paint, the electric furnace and its products, and the technical extraction of the less common elements.

Prerequisites: Courses I. and II.

Two hours per week during the second semester of the Sophomore year. (Bailar.)

XIII. METALLURGICAL CHEMISTRY.

This course, essentially a laboratory course, embraces work requiring skill, accuracy, and experience acquired in the preliminary courses. The student performs operations which bring him into touch with the products of less common metallurgical processes, and also acquires a good idea of chemical practice used in conjunction with common metallurgical operations which he himself performs or observes. Naturally this adds to the knowledge, speed, and accuracy expected of him in actual practice. Among the tasks imposed are the estimation of arsenic, antimony, bismuth, nickel, cobalt, mercury, cadmium, tin, the examination of electrolytic slimes, the application of previously acquired knowledge in checking actual metallurgical operations and the study of electrolytic methods of analysis and of the more useful rare metals.

Prerequisites: Courses VII. VIII. IX. and X.

Six hours per week during the first semester of the Junior year. (Fleck.)

PHYSICS.

PROFESSOR EDSON RAY WOLCOTT.

In arranging the courses of this department the aim has been to make them as practical as possible, emphasizing those phenomena that bear directly on engineering problems, and yet not neglecting those facts which, though not so important of themselves, still are highly valuable in showing the close relationship that exists between physical laws. Special attention is given to problems involving the use of these laws, to actual demonstrations of their validity, and, as far as possible, to laboratory work verifying them quantitatively.

I. GENERAL PHYSICS.

This course consists of lectures, illustrated by experiment, and recitations with assigned problems. The subjects treated are as follows: mechanics, including the elements of kinematics, dynamics and hydrostatics; the properties of matter; heat, including thermometry and expansion, calorimetry, change of state, conduction, radiation, and the elements of thermodynamics; sound, including wave motion in general, production and propagation of sound waves, pitch, reflection, refraction, interference and resonance.

Prerequisites: Mathematics, Courses I. to IV. inclusive.

Text: Watson, *A Text-Book of Physics.*

This course must be preceded by or taken in conjunction with Mathematics V.

Three lectures and one recitation per week during the first semester of the Sophomore year. (Wolcott.)

II. GENERAL PHYSICS.

This course is a continuation of Course I. The subjects treated are as follows: light, including propagation, reflection, refraction, dispersion, interference, emission, absorption, and polarization; electricity and magnetism, including electro-statics, electro-kinematics, thermo-electricity, magnetic induction, electro-magnetism, electrolysis, the electro-magnetic theory, and electric oscillations.

Prerequisite: Course I.

This course must be preceded by or taken in conjunction with Mathematics VI. and VII.

Text: Watson, *A Text-Book of Physics.*

Three lectures and one recitation per week during the second semester of the Sophomore year. (Wolcott.)

III. PHYSICAL LABORATORY.

This course is arranged to accompany Course I. Its aim is to teach the student the necessity of careful work as well as to acquire skill in physical measurements so that the important physical laws can be quantitatively verified.

Prerequisites: Mathematics, I. to IV. inclusive.
Physics, I. must be taken in conjunction with this course.

Text: Ames and Bliss, *A Manual of Experiments in Physics.*

Three hours per week during the first semester of the Sophomore year. (Wolcott.)

IV. PHYSICAL LABORATORY.

This course is a continuation of Course III.

Prerequisite: Course III.

Physics II. must be taken in connection with this course.

Text: Ames and Bliss, *A Manual of Experiments in Physics.*

Three hours per week throughout the second semester of the Sophomore year. (Wolcott.)

MATHEMATICS.

Professor Charles Roland Burger.
Instructor Alwyn Charles Smith.

The courses in this department have been arranged to meet the extensive needs of students in the various branches of engineering. The subjects are treated so as to give the student both logical training and power of application. The principles which are of greatest value in engineering work are particularly emphasized. The courses offered serve as a sufficient prerequisite for the work in mathematical physics, physical chemistry, engineering and applied mechanics; and they mark the minimum of mathematical attainments that an engineer ought to possess. A special feature of the work is the early introduction of the calculus. By this means the principles of this subject are allowed to develop slowly, their sphere of usefulness is widened, and the student is able, early in the course, to make direct application of his knowledge of mathematics to practical problems.

I. COLLEGE ALGEBRA.

This course begins with a comprehensive treatment of quadratics. The fundamental operations are constantly kept in mind and the student is drilled in the reduction of actual problems that come up later in his course. Graphic representation of equations is early introduced in the belief that the illumination which it affords greatly enlivens the entire presentation of the subject and brings algebra into closer relationship with the other mathematical courses. The progressions, inequalities, proportion, and variation, convergency and divergency of series, undetermined coefficients with applications to partial fractions and expansion of functions in series, the binomial theorem, logarithms, exponentials, permutations and combinations, continued fractions, determinants and those propositions of the theory of equations that lead to the determination of the roots of numerical equations, are all amply treated.

Prerequisites: Entrance requirements.

Text: Hawkes, *Advanced Algebra.*

Five hours per week during the first semester of the Freshman year. (Burger, A. C. Smith.)

II. TRIGONOMETRY.

The general formulæ of plane and spherical trigonometry are developed. Much practice is given in the use of tables and the applications of trigonometry to mensuration in general. The astronomical triangle and such problems relating thereto as come up in surveying are dwelt upon particularly and graphic representation is given its needed emphasis.

Prerequisites: Entrance requirements.

Texts: Phillips and Strong, *Plane and Spherical Trigonometry.*
Vega, *Logarithmic Tables.*

Three hours per week during the first semester of the Freshman year. (Burger, A. C. Smith.)

III. ELEMENTS OF ANALYSIS.

This is a practical course in advanced algebra and in the elements of the differential calculus. The language, the symbols and the first processes of infinitesimal calculus, both in the pure and applied form, are explained. Many illustrations in geometry, physics, engineering, and applied mechanics are introduced. The fundamental principles of continuity, limiting values, theory of infinitesimals, and the differentation of the elementary forms are established. Application is made to problems involving maxima and minima, rates, and to theorems in analytic geometry. Many simple problems are frequently assigned to acquaint the student with the fundamental operations of the calculus.

Prerequisites: Courses I. and II.

Text: *Mimeographed Notes.*

Three hours per week during the second semester of the Freshman year. (Burger, A. C. Smith.)

IV. ANALYTIC GEOMETRY.

The analytic geometry of the straight line, circle and conic sections, including a discussion of the general equation of the second degree, is amply treated. Methods of the calculus are introduced. In the solid analytic geometry, besides the plane and the straight line, the cylinders and the surfaces of revolution are treated, and all the quadric surfaces are studied from the simplest forms of their equations.

Prerequisites: Courses I. and II.

Text: Bailey and Woods, *Analytic Geometry.*

Five hours per week during the second semester of the Freshman year. (Burger, A. C. Smith.)

V. DIFFERENTIAL AND INTEGRAL CALCULUS.

This course is a continuation of Course III. in which students are made familiar with the ordinary processes and applications of the calculus. A principal feature of this subject consists in carrying on the development of the differential and of the integral calclulus together. This method of instruction enables the student to grasp the more difficult notions of the subject in their inherent relations, and at the same time to apply this knowledge, early in the course, to the solution of engineering problems.

Prerequisites: Courses I. to IV. inclusive.

Text: Murray, *First Course in Infinitesimal Calculus.*

Five hours per week during the first semester of the Sophomore year. (Burger, A. C. Smith.)

VI. INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS.

This course is a continuation of Course V. The notion of a definite integral is stated in its fundamental and most comprehensive form. The aim is to make clear the *rationale* of each process, and to encourage the student to become independent of formulæ of integration. The theory of single and multiple integration is applied to the principal methods of rectification and quadrature, and to the calculation of the surfaces and volumes of solids of revolution. The student is also given many useful and practical applications of the integral calculus. These include the general method to be employed in obtaining the position of a centroid, the value of a moment of inertia, and other practical problems in physics, engineering, and applied mechanics. For the sake of students in engineering, who wish to use differential equations and have little time to devote to general theory, the theoretical explanations are made as brief as is consistent with clearness and sound reasoning. Practical applications dealing with geometrical, physical, and mechanical problems are constant sources of discussion.

Prerequisites: Courses I. to V. inclusive.

Text: Murray, *First Course in Infinitesimal Calculus.*

Three hours per week during the second semester of the Sophomore year. (Burger, A. C. Smith.)

VII. THEORETICAL MECHANICS.

In this course prominence is given to those principles and results which the student finds to be a direct application of the theoretical mathematics and physics, as well as those that are of great importance in giving proper development and understanding for the work of mechanical engineering in the Junior year. Along with the analysis processes, graphical methods are introduced as aids to the understanding of the general principles. The course is intended to bridge the chasm between pure and applied mathematics.

Prerequisites: Courses I. to V. inclusive.

Text: Johnson, *Theoretical Mechanics.*

Two hours per week during the second semester of the Sophomore year. (Burger, A. C. Smith.)

INSPECTION TRIPS.

The same importance is attached to the inspection trips as to class room and laboratory work. Grades are given on reports submitted and satisfactory results are required for graduation.

MINING TRIPS.

Throughout the four years the classes make many trips to mines in order to see the varying practice and the operations and machinery described in the class room. The trips are planned to illustrate definite operations, to develop the power of observation and the ability to report concisely such observations. Each new student is encouraged to make a study of some district and, whenever possible during his college course, to apply principles, methods, and criticisms to that district.

During September and October, 1905, the Freshman class inspected the following in Gilpin County: Running Lode Mine, Gregory-Buell Mill, Rocky Mountain Concentrator, Bobtail Tunnel, Cook Mine, Boston and Denver Mill, Oldtown Mine, Ontario-Colorado Mine, La Crosse Tunnel, and Pewabic Consolidated Mines. During March, 1906, the Freshman Class inspected the following at Idaho Springs: Stanley Mine, Newhouse Tunnel, Central Tunnel, Shafter Mine, Consolidated Gem Mine and Miami Tunnel.

During March, 1906, the Sophomore Class inspected the following in the Cripple Creek District: Portland, El Paso, Vindicator, Elkton, Mary McKinney, Strong, and Abe Lincoln mines, and the Taylor and Brunton Sampler.

During the Junior year a trip to Leadville is made in order to illustrate practice in shaft sinking, tunneling, and hydraulic mining. Methods of mining and handling low-grade ore are well illustrated on this trip. The equipment of mine plants is studied carefully, and available data are collected by each student in order to furnish practical examples in the study of mine plants during the Senior year.

METALLURGICAL TRIPS.

Immediately after taking up the study of metallurgy, trips extending throughout the Junior and Senior years are begun. These trips, intended to illustrate the lectures, are taken while the particular topics are under discussion, and tend to aid greatly in an appreciation of approved machinery and practice. By means of outlines furnished the student, which he is required to fill out, care is taken that all the important points in connection with each plant visited are studied and reported upon.

During the Junior year the following plants are visited:

The plant of the Denver Gas and Electric Company at Denver, for a general study of artificial fuels.

The Globe plant of the American Smelting and Refining Company at Denver, and the Independent Smelter at Golden, for a study of furnaces of various types.

The Minnequa plant of the Colorado Fuel and Iron Company at Pueblo, for a study of the manufacture of iron and steel and the working up of the product into commercial forms.

The Pueblo and Eiler's plants of the American Smelting and Refining Company, for a study of the metallurgy of lead.

The zinc plant of the American Smelting and Refining Company at Pueblo, and the plants of the Empire Zinc Company, and the United States Smelting Company at Canon City, for a study of the metallurgy of zinc.

During the Senior year the following plants are visited and reported upon:

The Jackson, Newton, Hudson, and other mills in Idaho Springs, for the study of ore dressing.

The various stamp mills of Black Hawk and Central City, for the study of amalgamation.

The Colorado Zinc Company and the Blake-Morscher works in Denver, for magnetic and electro-static separation.

The Boston and Colorado Company's plant at Argo, for the metallurgy of copper.

The cyanide mills of Idaho Springs, Colorado City, and Cripple Creek for the cyanide process.

The Portland and Standard mills at Colorado City, for the chlorination process.

POWER PLANT INSPECTION TRIPS.

At the close of the course in Electric Power Transmission a visit is made to several power plants, so that the apparatus studied in class can be seen in practical operation. Among these are the Clear Creek sub-station and the Platte street station of the Denver Tramway Company, and the West Side station of the Denver Gas and Electric Company. These plants are selected because of the representative apparatus in both direct and alternating current practice.

MINING MACHINERY TRIPS.

In order to become familiar with the structural features of the different machines commonly used in mining operations, occasional trips are made to Denver plants that manufacture or deal in mining machinery. Students are frequently permitted to take down and reassemble machinery and thus gain an intimate knowledge of the details not to be acquired in any other way. Among the houses visited are the following: The Hendrie & Bolthoff Manufacturing and Supply Company, The Colorado Iron Works Company, The Denver Engineering Works, Fairbanks, Morse & Company, and The J. George Leyner Engineering Company.

TECHNICAL CHEMISTRY TRIPS.

In connection with the course in Technical Chemistry inspection trips are made to the following: The Western

Flint Glass Company, The Denver Sewer Pipe Company, The Denver Stoneware Company, The Western Chemical Manufacturing Company, and The Golden Pressed and Fire Brick Company.

SENIOR TRIP.

At the conclusion of the Senior year an extended trip is made for advanced work in geology, metallurgy, and mining, to points in Colorado, Utah, Montana, and South Dakota. Illustrating lecture work in these subjects, this trip gives the prospective engineer a splendid opportunity to round out his collegiate work and enables him to get more closely in touch with actual practice. The points visited include Colorado Springs, Pueblo, Florence, Portland, Canon City, Leadville, and Aspen in Colorado; Bingham, Murray, Salt Lake, Park City, Eureka, Milford, Frisco, and Newhouse, in Utah; Butte and Anaconda, in Montana; and Deadwood, Terry, and Lead, in South Dakota.

In connection with so extensive a trip many and constant opportunities are given to study the relationship of geology to mountain formation and to physiographic forms. In addition to such general observation, special opportunities are given to study geological features in detail. This is especially true of the interesting geology of the Garden of the Gods at Manitou, and of the equally interesting problems involved in the ore deposits of Leadville, Aspen, Butte and other mining districts.

This trip coming, as it does, after the completion of all laboratory and lecture work in ore dressing and metallurgy affords a broader point of view than is possible at any other stage of the course. Advantage is taken of this condition to make a critical study of operations and plants, and in particular to study variations in treatment and general operation as affected by local surroundings. Comparisons of practices in different localities are carefully made, because the results of such study afford a basis for solving such problems of treatment as the student may meet in his professional practice.

Iron, copper, zinc and lead smelting may all be studied on the trip, as well as cyanidation and chlorination. Magnetic concentration and electro-metallurgy are important features and wet concentration as illustrated at Anaconda, Park City, and Aspen receives careful study. Metallurgically the trip is of great value and most of the important processes are shown under excellent conditions. From a mining standpiont the trip illustrates the economic mining and handling of low grade ores and especially the general design, equipment and organization of the mine plant. The special features include mining methods, pumping, and timbering at Leadville, mining methods and wire rope trams at Bingham and Park City; mine plant at Newhouse; and general mining practice and organization at Butte.

Detailed work is assigned each student according to his preference and there is a splendid opportunity to make a study of special conditions, operations, and machinery. The results of the student's investigations are carefully criticised and he is required to prepare a complete report on the trip.

BUILDINGS.

SIMON GUGGENHEIM HALL—Administration Building.

This building, the gift of Mr. Simon Guggenheim, of Denver, was erected and furnished at a cost of $80,000. The corner stone was laid by the A. F. and A. M. of Colorado, October 3rd, 1905. It is one hundred sixty-four feet long by fifty-seven feet wide and is surmounted by an ornate tower. The first floor is devoted entirely to the Department of Geology and Mineralogy, and includes lecture room, laboratory, office, two work rooms and public museum; the second floor contains the library, the office of the President, Secretary, and Registrar, the Faculty Room and the Trustees' Room; the third floor contains the Assembly Hall, two lecture rooms for mathematics and two offices, The building was dedicated October 17th, 1906.

HALL OF CHEMISTRY.

This is a continuous group of brick buildings, comprising the buildings of 1880, 1882, and 1890. The combined buildings of 1880 and 1882 contain the main chemical laboratories. In the building of 1890 are located the office and laboratory of the professor of chemistry, the chemical lecture room, the technical museum, two recitation rooms, the laboratories for gas and water analysis, the Freshman drawing room, and the gymnasium.

ASSAY BUILDING.

This building, a brick structure forty-six by ninety-two feet, was built in 1900 through funds contributed by the late W. S. Stratton, and enlarged in 1905 by an addition, to allow for the installation of a new equipment of furnaces of the gasoline type. The design and equipment of this building are such as to make it probably the best of its kind in the country.

HEATING, LIGHTING, AND POWER HOUSE.

The power plant recently erected at a cost of forty thousand dollars, was designed to furnish light, heat, and power to the entire school. It is a simple but artistic brick building, eighty-three by one hundred twenty-two feet, with concrete floors and tile roof. The building is divided lengthwise into an engine room thirty-four feet wide, and a boiler room forty-five feet wide. A conduit six feet wide and seven feet high surrounds the engine room below the floor and is used for steam and electric mains. A brick-lined steel stack one hundred twenty-five feet high carries all smoke to the upper air and away from the buildings. The end walls of the power house extend across a private alley and unite with the end walls of the Assay Laboratory, giving the two buildings a pleasing appearance of unity.

HALL OF ENGINEERING.

This building, constructed of red pressed brick, consists of two floors and a basement, and was completed in the fall of 1894. The upper floor contains the Junior and Sophomore drafting rooms, the blue print room, and a private office. The physics lecture and apparatus room, the photometry room, the physical laboratory, the balance room, and the apparatus rooms, as well as the private office, occupy the first floor. The basement contains the electro-metallurgical laboratory, three electrical laboratories, a battery and switchboard room, and a small shop.

STRATTON HALL.

The corner stone of this building was laid by the A. F. and A. M. of Colorado, on November 20, 1902, and was completed in January, 1904. The basement wall and first story are of Lyons sandstone, in broken ashlar, topped by a story of gray Golden brick. The building is finished on the interior with red pressed brick, and little wood is used, except that in the floors and staircases. The basement accommodates the metallurgical and ore dressing laboratories. The first floor contains two large lecture rooms, each with apparatus room and private office. The second floor, in one-half, accommodates the surveying and mechanics in one large lecture room, with apparatus room and private office, and in the other half a drafting room. The third floor is devoted entirely to a large drafting room for the Senior class. The structure was named in honor of the late W. S. Stratton, whose gift of twenty-five thousand dollars made the building possible.

RESIDENCE OF THE PRESIDENT.

This is a brick building of two and one-half stories. It was built in 1888.

CARPENTER SHOP.

This is well equipped for the special demands which are continually arising in a technical school. The work varies from ordinary repair work to the careful construction of special apparatus needed in the various departments of the school.

MACHINE SHOP.

What has been said of the carpenter shop is equally true of the machine shop. It is imperative that the school have shops of its own, in order to keep its mechanical apparatus in proper working order, as well as to construct such apparatus as is necessary to carry on any new or original work. The machines of both shops are driven by direct connected motors.

LABORATORIES AND EQUIPMENT.

MINERALOGICAL AND GEOLOGICAL LABORATORY AND CABINET.

Under the name cabinet is embraced not only the distinctively display collections, which may perhaps be called the cabinet proper, but also the other collections that have been prepared mainly for the purpose of class instruction. These collections are necessarily changing rapidly from year to year, as new material is constantly being added. This new material is obtained partly by purchase, but mainly by direct collecting, and by means of exchange with other institutions. The display collections are not classified systematically, but are arranged in different cases with a view to displaying certain groups of minerals or minerals from certain localities. The display collections are to be found in flat glass-topped cases and the other collections in cases of drawers.

Among the more interesting displays are quartz and microcline crystals from Florissant, Colo.; golden calcites from Joplin, Mo.; fluorite and barite from England; epidote crystals from Alaska; pyroxene, epidote, and magnetite crystals from Salida, Colo.; sphalerite crystals from Kokomo, Colo.; pyrite crystals from Gilpin county, Colo.; crystallized sulphur from Sicily; dolomite and calcite from Ouray county, Colo.; geyserite from the Yellowstone National Park, and, above all, several cases of zeolites (thomsonite, mesolite, analcite, chabazite), from North Table Mountain, Golden, Colo. The case of mesolites is unique as well as beautiful, as it cannot be duplicated by any cabinet in the world.

The various collections are classified as follows:

First. *A Mineral Type Collection*, consisting of well-characterized specimens to be used by the student for the purpose of study and comparison. This collection at present contains specimens representing two hundred seventeen species and sixty one additional varieties. These specimens come from many countries, but Colorado minerals are especially well represented.

SECOND. *A Display Collection,* mainly ot large and fine specimens of minerals and rocks. Many graduates and mining men, friends of the institution, have contributed gifts to this collection.

THIRD. *A Supplementary Collection,* containing the rarer and more expensive minerals not placed in one of the above mentioned collections.

FOURTH. *A Descriptive Collection,* illustrative of the terms used in describing the various structural, physical, optical, and other properties of minerals.

FIFTH. *A Student's Working Collection of Minerals,* consisting of over twenty thousand unlabeled specimens, similiar to those in the type collection, to be used by the student for study and determination.

SIXTH. *A Crystal Collection,* consisting of natural crystals to be used in the determination of crystal forms.

SEVENTH. *A Crystal Model Collection,* containing a large number of glass and wooden models used in the study of crystallography.

EIGHTH. *A Blow-Pipe Collection,* containing materials used in blow-piping.

NINTH. *Rock Type Collection,* containing (a) a collection of rocks from different countries of the world; (b) a series of Colorado rocks; (c) various rocks illustrative of structural features.

TENTH. *A Working Rock Collection,* containing miscellaneous unlabeled rocks, to be used by students in connection with the study of lithology.

ELEVENTH. *A Collection of Fossils,* to be used in connection with the course in historical geology.

TWELFTH. The United State Geological Survey Educational Series of Rocks.

THIRTEENTH. Professor Patton's private collection of minerals.

FOURTEENTH. Professor Patton's private collection of rocks.

SUMMARY OF COLLECTIONS.

Type Collection of Minerals	3,700
Working Collection of Minerals (about)	21,000
Display Collection of Minerals	1,305
Supplementary Collection of Minerals	950
Crystal Collection	1,800
Display Collection of Fossils	342
Miscellaneous Collection of Fossils	1,360
Type Collection of Rocks	1,800
Working Collection of Rocks	7,408
United States Geological Survey Educational Series of Rocks	156
Professor Patton's Collection of Rocks	1,700
Professor Patton's Collection of Minerals	970
Summary of specimens	42,491

EXCHANGES.

The college has prepared a printed list of exchange material, covering both minerals and rocks. The list will be sent to all who wish to arrange for exchanges. Correspondents should state what material they are prepared to offer in exchange, and letters should be addressed to Professor H. B. Patton, Golden, Colo.

MINERALOGICAL LABORATORY.

Aside from the special advantages due to location the Department of Geology is admirably equipped for practical teaching. The entire first floor of Guggeheim Hall is occupied by this department. The south end of the building is occupied by a commodious lecture room, with a seating capacity of over a hundred, and by a separate mineralogical laboratory with table space for between fifty and sixty students, also by two small recitation rooms. On the extreme north end of the building is the public museum, devoted to a display of fine minerals. Additional space is provided for working rooms, offices, packing, and storage rooms.

METALLURGICAL COLLECTIONS.

The college has the advantage of a fine collection of models from the works of Theodore Gersdorf, Freiberg, Saxony, illustrating the best type of furnaces in this and other countries. Each model is made to a scale and is complete in every detail. In addition to these models are the following illustrating the best modern practice:

Working model of twenty-stamp mill, on scale of one and one-half inches to the foot.

Working models of crushing rolls, same scale.

Working model of a Dodge crusher.

Model of modern blast furnace for lead-silver ores, with water-jacket.

There are also a large number of smaller models, such as the completed set used in the famous Keyes and Arents lead-well suit.

The collection of ores and metallurgical products is constantly being augmented.

METALLURGICAL LABORATORY.

This laboratory is equipped with apparatus for the study of the quantitative relations of the various agencies taking part in metallurgical changes.

The Junker, the Mahler Bomb, and the Parr calorimeters, the Wanner optical and the Le Chatelier electrical pyrometers together with sets of the American Gas Furnace Company's gas furnaces and Hoskin's gasoline furnace are used for securing the desired temperature for experimentation. These furnaces also serve for the necessary assaying demanded in the metallurgical laboratory. Desks and apparatus are provided for small scale work in amalgamation, chlorination, and cyanidation, while for larger scale work a battery for eight amalgamation pans, devised to be operated together or independently by power, several sets of cyanide tanks, including a Braun Laboratory Cyanide plant, and a chlorination barrel, are provided.

ORE DRESSING LABORATORY.

The equipment of the ore dressing laboratory, which is rapidly increasing, at present consists of the following apparatus: Sturtevant roll jaw crusher, Colorado Iron Works rolls, Forster crusher, Case crusher, Bosworth crusher, Vezin disc pulverizer, Braun's Perfection crusher, Braun's disc pulverizer, Braun's Chipmunk crusher, Braun's sampling machine, Denver Engineering Works Sample grinder, Wilfley table, Card concentrating table, accelerated pulsation jig, set of spitzkasten and all the necessary apparatus for systematic sampling of large and small parcels of ore.

For small scale work, Munroe's slime table, Vezin jig, Munro classifiers, and other devices, are supplied.

ELECTRO-METALLURGICAL LABORATORY.

The electro-metallurgical laboratory is located in the basement of the Hall of Engineering and includes, besides the main room, a room for the storage battery, a room for cleaning and polishing, and switchboard.

In the main room are located experimental tables with electrical connections and appliances for work in electrochemical analysis and vats for the deposition and refining of metals. In any part of the room access to various sources of electrical energy is readily obtained by means of a central switch board.

ASSAY LABORATORY.

This laboratory is well equipped with parting, balance and store rooms and office, and has thirty-two coal-fired muffle furnaces. Each student has his own muffle, with his own coal bin, pulp balance, and desk, conveniently arranged with regard to his furnace; he has also access in the balance room to the best assay balances to be obtained on the market.

A recent addition to the building has increased the available furnace room by fifty per cent, and this added space has been utilized by the installation of an equipment of the most recent types of gasoline furnaces. The list includes, one crucible, four combination, three muffle furnaces, one crude oil burner, tempering furnace, a bullion and tempering furnace, all of the F. W. Braun & Co. type; also three Case muffle furnaces, and one Case crucible furnace, two Braun cupel machines, two Iler cupel machines and two Coronet rolls, one of which is of the Braun type. In order to avoid dust, change of temperature, and direct sunlight, the balance room has no outside walls, but is lighted by means of skylights. The equipment here includes six pulp balances, five silver, three gold balances, and one Thomson multiple rider balance. The variety of makers is as great as possible, so as to acquaint the student with the various mechanisms and adjustments in assay balances.

MINING LABORATORY.

Extensive additions have recently been secured for this laboratory, so that tests can now be made on a large number of the machines used in mines and in mine plants. A De Laval turbine direct-connected to two 37½ kilowatt Bullock generators is well arranged for providing practice in testing the efficiency of a steam turbine under varying conditions of load. There are also two working size models of the Bleichert system of aerial trams erected by the Trenton Iron Works Co. This equipment supplements the apparatus of the steam laboratory in providing a testing laboratory for mining machinery, but includes, as well, special equipment not found in the ordinary power plant. In this special equipment are included seven pumps, a two stage Leyner air compressor and rock drills of the following patterns: Box, Hardsocg, Ingersoll, Leyner, McKiernan, Shaw, Iler, and Wood. All the accessories necessary for the operation of these drills are provided as well as a complete equipment for the sharpening and tempering of drill steel.

MINING EQUIPMENT.

The mining equipment consists of models, maps, photographs, and lantern slides, illustrating mines and mining operations; safety lamps; instruments for measuring ventilation; an explosive tester; an electric firing apparatus, and models of timbering. The character of material mined is shown by an extensive collection of ores and rocks. Models of machinery and appliances, samples of rope, valves and injectors supplement the college power plant in illustrating the essentials of mine plants. Numerous reports on mines and plants have been collected to illustrate the practice of engineers and the economy in the operation of power machinery.

STEAM LABORATORY.

The Heating, Lighting, and Power Plant is well equipped for steam laboratory practice. New Babcock and Wilcox boilers, with automatic chain grates, are so set in units as to develop at pleasure 100, 200, or 300 horsepower. The steam generated supplies heat to all of the buildings and furnishes power for operating the machinery in the laboratories. There are also a fuel economizer, a superheater, a feed water heater, boiler feed pumps, eight 25 ton steel bunkers, coal track, ash conveyor and elevator. A tubular boiler and high speed automatic engine are used for testing purposes. There is also a fifteen horsepower throttling engine, and a small slide valve engine, which is used chiefly in illustrating valve setting. Calorimeters, measuring tanks, scales, various gages and gage testers, indicators, separators, traps, continuous counters, recording counters, speed indicators, injectors and other apparatus are included in the laboratory equipment.

PHYSICAL LABORATORIES.

The physical laboratories are located on the first floor and basement of the Hall of Engineering, and include, besides the lecture room and general laboratory, several special rooms fitted up with heavy piers for advanced work. The equipment is arranged especially for the instruction of students of engineering, and includes, besides the ordinary demonstration and laboratory apparatus, a special apparatus for the determination of the mechanical equivalent of heat, the expansion of metals, the moment of inertia, the elastacity of metals by bending, twisting and stretching, and a complete Lummer-Brodhun photometer. The electrical laboratories are well equipped with galvanometers, standard resistances, condensers, ammeters, voltmeters, dynamometers, permeameters, standard cells and a Kelvin balance.

CEMENT LABORATORY.

The apparatus in this laboratory consists of a 1,200-pound Riehle testing machine for testing briquettes in tension. A nest of sand sieves gages the sand used in tests. Scales and volumeters are provided for measuring quantities in bulk. The specific gravity of cement is determined by means of Le Chatelier apparatus. A nest of fineness sieves and a very sensitive set of scales equip the student for the fineness test. Setting is determined by means of the complete Vicat apparatus. Trowels, spatulas, large slate mixing boards, beakers, moulds, and immersing vats, provide apparatus for the making and setting of briquettes and for the soundness tests. Glass baths for chemical tests, trays for heaviness tests, and other general facilities, permit the most extensive investigations.

TESTING LABORATORY.

The laboratory is provided with a motor driven 100,000-pound Riehle testing machine arranged for experiments in tension, compression, shearing, and flexure of materials of construction. Extensometers for measuring elongations and compressions are employed. Numerous steel sections provide useful problems in determining centers of gravity and moments of inertia. Experiments to determine the strength of threaded bolts, riveted joints and nailed joints are included in the course.

HYDRAULIC LABORATORY.

The hydraulic laboratory contains weirs and orifice tanks for the determination of coefficients of discharge, calibrated tanks for water measurement, a steel pressure tank for artificial heads, pumps for water supply and gages for pressure. A hydraulic ram is used to illustrate this class of apparatus and for testing. A long sheet iron trough, with a car over it is used for calibrating current meters. Water wheels and centrifugal pumps are tested for efficiency under various conditions of head and load. Hook gages are used for the accurate determination of low heads. Streams and ditches in the vicinity of Golden are gaged by means of the current meter, by rod floats, and by slope.

ELECTRICAL LABORATORY.

This laboratory is equipped with standard voltmeters, ammeters, and wattmeters, inductive and non-inductive resistances for artificial loads and a number of transformers.

The power equipment of the school available for laboratory work includes one 15 K. W. 150 volt compound wound direct current generator, one 1½ K. W. 125 volt shunt generator, one 2 K. W. 120 volt compound wound Brush incandescent light generator, one series arc light machine, one 30 K. W. 1100 volt compound wound 125 cycle single phase alternator, numerous constant speed and variable speed motors for direct current and a single phase induction motor.

In addition to the school current, the 60 cycle circuits of the Golden Illumination Company are available for power and light. From this source can be obtained voltages of 120, 250 and 2300, single or three phase.

CHEMICAL LAEORATORIES.

The Freshman, Sophomore and Junior laboratories accommodate two hundred sixteen students, and are equipped with especially designed tile topped oak desks, provided with low reagent shelves, gas, water, filter pumps, and large procelain sinks. The balance rooms are equipped with

Sartorius, Becker, and Spoerhase balances. Gas is supplied to the building from a 300 light Detroit gas machine, which is connected with buried supply tanks outside the buildings. Good ventilation is obtained by means of two Sturtevant fans.

Research Laboratory. This laboratory is set apart for the needs of the department in its work of a research nature It is equipped with tile topped tables, ample hood space, gas, water, and electricity.

Gas Analysis Laboratory. Adjoining and communicating with the research laboratory, is placed the gas analysis laboratory. Throughout the day the room affords an even temperature and is well lighted. The tile topped table along the wall provides ample working space. Window space is reserved for a Lothar Meyer modification of the Bunsen eudiometer and a cathetometer. The laboratory also contains a complete Hemple and Elliott outfit, together with special apparatus for the collecting, storing, and handling of gases.

Water Analysis Laboratory. This laboratory adjoins and communicates with the gas analysis laboratory,and contains a full equipment of ordinary and special apparatus for water analysis. It is situated apart from the general laboratories and is particularly free from contaminating fumes.

SURVEYING EQUIPMENT.

The equipment of the department of surveying is well adapted to the practical course given. Students are organized into parties for field work. Each party is assigned instruments, rods, flags, steel measuring tapes, marking pins, hatchet, plumb bob, and other essentials are furnished from time to time as may be necessary. For transit work there are ten light mountain transits, six of which are provided with solar attachments for determining the meridian and latitude and eight of them are provided with auxiliary telescopes for underground work. There are also three heavy transits, one of which is of English and one of German make. In addition to the transits there is a plane table for taking topography.

For leveling, six wye levels of standard manufacture are used. The department is well supplied with leveling rods of various makes and types, stadia rods, hand levels, clinometers, flagpoles, and other accessories.

The instruments noted above are manufactured by such well-known firms as C. L. Berger and Sons, Buff & Buff, Heller & Brightly, Eugene Dietzgen & Co., Peter Heer & Co., W. and L. E. Gurley, Keufel and Esser, Wm. Ainsworth & Sons, Young and Sons, Negretti and Zambra (English) and Max Hildebrand (Freiberg, Germany). Additions are constantly being made, keeping pace with the growth of the school and replacing worn-out instruments.

DRAWING ROOMS.

FRESHMAN. This occupies the whole of the top floor of the Hall of Chemistry. The floor area is about four thousand square feet. It is lighted by windows on the north, east, and west, and by eight large skylights in the roof. A suitable office for the instructors is located in a central position, in which all drawings are filed and all records kept. Each student is provided with a drawing table, a drawer, a drawing board, and a stool. The present equipment will accommodate about one hundred twenty-five students.

JUNIOR. The second floor of the Hall of Engineering is used for the Junior drawing. There are two drawing rooms, each twenty-seven by fifty feet. They are lighted by windows on three sides and by skylights. Each student is provided with a drawing table, a drawer, a drawing board, and a stool. The tables are independent of each other and are adjustable. The present equipment accommodates about seventy-five students. There is a blue print room fully equipped with an adjustable printing frame and all other necessary appliances; also an office for the instructor, where all drawings and records are filed.

SENIOR. The drafting of the Senior year is given in the drafting room on the second floor of Stratton Hall.

TECHNICAL MUSEUM.

The Technical Museum is located on the first floor of the Hall of Chemistry. The object in establishing this museum is to aid in a practical way the courses in applied chemistry and metallurgy. Mounted specimens of raw materials, main products, by-products, and waste products of the various branches of technical chemistry and metallurgy are a direct stimulus in the study of these branches. The specimens already collected for the museum represent among other things, the various stages of the manufacture of brick; tile; cement; electrolytic alkalis; natural alkalis; electrolytic furnace products; carborundum; alundum; carbide; rare metals; ferro alloys and dye stuffs.

EXPENSES.

TUITION.

The Statutes of Colorado provide as follows:

> "The said School of Mines shall be open and free for instruction to all bona fide residents of this State, without regard to sex or color, and, with the consent of the Board, students from other states and territories may receive education thereat upon such terms and at such rates of tuition as the Board may prescribe."

The tuition for non-residents until the college year of 1908-9 is one hundred dollars per year. This is payable in two instalments—fifty dollars at the begining of each semester. For the college year beginning in September, 1908, and thereafter, the annual tuition will be one hundred fifty dollars, payable in two instalments—seventy-five dollars at the beginning of each semester. This increase in tuition does not apply to students entering the school and in regular attendance before the opening of the school year 1908-9.

FEES AND DEPOSITS.

Deposits are required to cover the cost of supplies consumed, and any unused balance is returned. Fees are charged to cover not only the cost of materials furnished, but also the wear on apparatus and supplies. No part of a fee is returnable.

Matriculation Fee (Paid once only)	$ 5.00
Locker Deposit (Paid once only)	1.00
Drawing Deposit (Paid once only)	2.00

FRESHMAN YEAR.

First Semester.

Athletic Fee	$ 5.00
Drawing Fee	.50
Qualitative Analysis Fee	20.00
Qualitative Analysis Deposit	15.00

Second Semester.

Athletic Fee	$ 5.00
Drawing Fee	.50
Qualitative Analysis Fee	20.00
Surveying Fee	5.00

SOPHOMORE YEAR.

First Semester.

Athletic Fee	$ 5.00
Quantitative Analysis Fee	10.00
Quantitative Analysis Deposit	15.00
Mineralogy and Blowpipe Fee	15.00
Physics Laboratory Fee	3.00
Surveying Fee	5.00

Second Semester.

Athletic Fee	$ 5.00
Quantitative Analysis Fee	10.00
Physics Laboratory Fee	3.00

JUNIOR YEAR.

First Semester.

Athletic Fee	$ 5.00
Drawing Fee	.50
Assaying Fee (Mining Engineering only)	20.00
Assaying Deposit (Mining Engineering only)	25.00
Metallurgical Chemistry Fee (Met. Eng. only)	10.00
Metallurgical Chemistry Deposit (Met. Eng. only)	15.00
Testing Laboratory Fee (Met. Eng. only)	2.00
Electrical Laboratory Fee (Met. Eng. only)	2.00

Second Semester.

Athletic Fee	$ 5.00
Drawing Fee	.50
Lithology Fee	3.00
Assaying Fee (Metallurgical Engineering only)	20.00
Assaying Deposit (Metallurgical Eng. only)	25.00
Testing Laboratory Fee (Mining Eng. only)	2.00
Electrical Laboratory Fee (Mining Eng. only)	2.00

SENIOR YEAR.

First Semester.

Athletic Fee	$ 5.00
Drawing Fee	.50
Ore Dressing Fee	5.00
Ore Dressing Deposit	5.00
Electro-Metallurgy Lab. Fee (Metallurgical Engineering only)	5.00
Hydraulic Laboratory Fee	2.00
Cement Laboratory Fee	2.00
Steam Laboratory Fee (Min. Eng. only)	2.00

Second Semester.

Athletic Fee	$ 5.00
Drawing Fee	.50
Thesis Fee	5.00
Metallurgical Laboratory Fee	5.00
Metallurgical Laboratory Deposit	10.00
Metallurgical Practice Fee (Mining Engineering only)	5.00
Metallurgical Practice Fee (Metallurgical Engineering only)	10.00
Mining Laboratory Fee (Mining Engineering only)	3.00
Graduation Fee	6.00

TEXT BOOKS AND STUDENT SUPPLIES.

The cost of text-books and students' supplies necessarily varies, but the following is a fair estimate:

Freshman Year:	Text-Books	$28.00
	Drawing Supplies	20.00
Sophomore Year:	Text-Books	17.50
Junior Year:	Text-Books	24.25
Senior Year:	Text-Books	16.50

BOARD AND LODGING.

The college has no dormitory. Board can be obtained in private families at from four dollars to six dollars per week. Students' clubs furnish board at about fourteen dollars per month. Rooms can be obtained from six dollars to twelve dollars per month.

OTHER EXPENSES.

There are other expenses incidental to the mining, metallurgical, and geological trips, which vary so widely that they cannot be estimated. The preparation of the Senior theses also involves expenses which vary with the nature and treatment of the subjects. For laboratory work in special cases a deposit of fifteen dollars is required. Students leaving in mid-term, except on account of severe protracted sickness are not entitled to the return of fees or tuition. *All charges of the college are payable strictly in advance at the beginning of each semester.* No student is allowed to be graduated while indebted to the school. The Trustees reserve the right to make incidental charges in fees and deposits without printed notice, as new and unforseen emergencies may arise.

Students who desire to earn money to defray their college expenses are advised to limit their work to the summer vacation. The course of study is too exacting to allow much time during the college year for outside work.

The total expenses of the college year, exclusive of tuition, need not exceed four hundred dollars, and may, by strict economy, be considerably reduced.

GENERAL INFORMATION.

ATHLETIC ASSOCIATION.

By virtue of the athletic fee required of all students, all students regularly entering the School of Mines become members of the Athletic Association. The association is supported by the students' fees, by gate receipts, and by contributions from the alumni and other friends of the college. The treasurer of the school, Harry M. Rubey, Woods-Rubey National Bank, selected by the Board of Trustees is, ex officio, treasurer of the association. The affairs of the association are managed by a board of control, which consists of seven members, three undergraduates elected by the students, an alumnus selected by the alumni association, and three members of the faculty selected by the president of the school.

The Board of Control for 1906-7 is:
Professor H. B. Patton, President.
Professor Herman Fleck, Vice President.
G. S. Krueger, '07, Secretary.
Assistant Professor, W. G. Haldane.
W. B. Lewis, '92.
W. A. Jones, Jr., '08.
Forrest Mathez '09.

SPANISH.

In response to the demand from students who expect to pursue their vocation in Mexico, a private class in Spanish is conducted by Mrs. B. J. French.

METHODS OF GRADING.

The following system of grading is used:

A—Excellent.
B—Good.

C—Fair.
D—Conditioned.
E—Failed.

A, B and C are passing grades.

D (Conditioned) means that the student is not passed. The deficiency may be removed by passing an examination or otherwise completing his work. Unless a condition is removed before the beginning of the school year following the year in which the condition is given, it becomes an E, and the subject must be taken again.

E (Failed) means that the subject must be repeated and no advanced subject which depends on this one can be taken until the E is removed.

Y. M. C. A.

The association building is situated directly in front of the campus, at the corner of Cheyenne and Fourteenth Streets, where the association has its headquarters and where frequent social gatherings are held in its parlors. The aim of the association is to develop Christian character and high ideals of manhood in the student body. It has the cordial support of the president, the faculty, the trustees, and the citizens of Golden. During the year an employment bureau is maintained for the benefit of students who seek to help defray their college expenses. At the beginning of the school year a board and room bureau is conducted for the benefit of the incoming students. In connection with this a room mate bureau is also maintained.

The work of the association is under the immediate charge of the general secretary, Ray C. Roberts, formerly connected with the Y. M. C. A. at the University of Colorado, and a graduate of that institution. A hand book of information is published annually, a copy of which can be obtained upon application to the general secretary.

An advisory board, consisting of two members of the faculty, one minister, one business man, and an alumnus, has general supervision of the entire work.

Advisory Board—Prof. Horace B. Patton, Prof. William G. Haldane, Rev. William N. Friend, Judge Charles McCall, Arthur C. Terrill.

The officers of the Association are: C. E. Lesher, President; H. V. D. Hunt, Recording Secretary; A. R. Kenner, Treasurer; C. L. Colburn, Bible Study.

LIBRARY.

The Colorado School of Mines library numbers about eight thousand volumes and four thousand pamphlets, selected with special reference to the instruction given in the school. Students and faculty are allowed free access to the shelves, and may draw books, which are not reserved for a special purpose, for home use. The card catalogue is arranged on the dictionary plan, and the classification is an adaptation of the Dewey decimal system to the needs of a technical library.

The library receives the publications of the leading scientific societies of the world, and the chief library and scientific periodicals. It is especially rich in files of journals relating to the various branches of mining engineering, and receives as gifts the maps and various publications of the United States Geological Survey, a number of other United States documents, and reports of various state geological surveys and mining bureaus.

During the biennial period just closed, the library has received as gifts five hundred five volumes and nine hundred sixty-two pamphlets.

The library is open from 8 to 12 a. m., 1 to 5 p. m., and 7 to 10 p. m., with the exception of Sundays and holidays.

GYMNASIUM.

The gymnasium, located in the north end of the Hall of Chemistry, is a valuable adjunct to the equipment of the college. The floor space, sixty-five by forty feet without posts, permits drill exercises of large classes, while the height of twenty feet allows the use of swinging apparatus and perfect ventilation. Hot and cold shower baths adjoin the gymnasium.

SCIENTIFIC SOCIETY.

The Scientific Society of the Colorado School of Mines has for its object the presentation and discussion of technical and engineering subjects. Original papers are prepared and read before the society by its active members. The editorial staff has in operation a comprehensive system for the review of current technical literature and the bringing before the society of the noteworthy and salient questions of the day. The addressing of an assembly by the students insures the stimulation of confidence, which is so essential to the technical and professional man in his career. From time to time, lectures are delivered before the society by the leading authorities on various topics of primary interest to its members and friends. The proceedings of the society are printed in its official publication, "The Bulletin," which is issued twice during the school year. The Alumni, Faculty, Senior and Junior classes of the college constitute the active members of the organization, while the Sophomores and Freshmen are associates.

Meetings are held at least once a month, often more frequently, in Simon Guggenheim hall.

Officers for the year 1906-07 are:

C. G. Warfel, '07, President.

T. P. Ellis, '07, Vice President.

C. L. Colburn, '07, Secretary.

A. M. Nash, '07, Treasurer.

P. A. Gow, '07, Manager of the Bulletin.

Ward Blackburn, '08, Assistant Manager of the Bulletin.

H. C. Armington, '07, Editor of the Bulletin.

S. F. Cline, '08, Assistant Editor of the Bulletin.

SOCIAL CLUB.

Social life in the college is fostered by a regularly appointed body of students consisting of three members from each class. Several receptions during the year are given under their management.

Class of '07.

R. E. Knight, President.
P. D. Grommon, Vice President.
C. G. Warfel.

Class of '08.

R. B. Elder.
L. C. Page.
W. V. De Camp, Secretary and Treasurer.

Class of '09.

H. A. Kruger.
A. B. Crosley.
Paul Neer.

Class of '10.

T. M. Skinner, Jr.
T. T. Williams.
K. H. Matheson.

PRIZES.

The Mining Reporter of Denver, through W. F. R. Mills, Proprietor, offers annually a prize of fifty (50) dollars for excellence in Senior thesis work.

At the Annual Commencement in May, 1906, this prize was awarded to Max W. Ball and A. J. Koerner for their thesis on the "Quartzite Area of Coal Creek, Jefferson County, Colorado."'

A. B. Frenzel annually offers one hundred fifty (150) dollars in prizes for excellence in the Department of Geology and Mineralogy and for Senior theses. At the Annual Commencement in May, 1906, these prizes were awarded as follows:

R. G. Bowman, $25.00 for excellence in Crystallography and Mineralogy.

A. G. Wolf, $25.00 for excellence in General Geology and Lithology.

C. Q. Schlereth, $25.00 for excellence in Economic Geology.

W. S. Kell, K. E. Neugebauer, C. Q. Schlereth, $75.00 for the Senior thesis on Uranium.

Mr. D. W. Brunton, of Denver, offers a Brunton Mining Transit for the best Senior thesis on any subject in which surveying forms a necessary part.

Mr. Frank Bulkley, member of the Board of Trustees, offers a prize of one hundred (100) dollars for the best Senior thesis involving the report on a mining property.

Mrs. Edward G. Stoiber offers a prize of two hundred (200) dollars, to be known as the "Edward G. Stoiber Prize Fund," in memory of her late husband, Mr. Edward G. Stoiber, for the best Senior thesis or theses involving the concentration of ores and the separation of metals.

ALUMNI ASSOCIATION.

The Association of the Alumni of the Colorado School of Mines holds its annual meeting and banquet on the day following the commencement exercises, unless otherwise provided by the Executive Committee.

All graduates holding degrees are eligible to membership, and are invited to the annual meeting and banquet.

The aim of the Association is to promote acquaintance and friendship among the graduates, to encourage them to aid each other, and to make an organized effort to elevate and uphold the reputation and standard of their Alma Mater.

All graduates are earnestly requested to join the organized body and to keep the Secretary advised as to their addresses.

The officers of the Association are:

H. A. Canning, '97, President.

O. R. Whitaker, '98, Vice President.

J. H. Steele, '00, Secretary,

P. O. Box 236, Denver, Colo.

C. L. Davis, '99, *Treasurer.*

G. B. Putnam, '05; E. E. Rowe, '95; W. H. Paul, '95, Executive Committee.

GIFTS TO THE COLLEGE.

ACHESON GRAPHITE COMPANY, Niagara Falls, N. Y.
Specimens of products.

PITTSBURG REDUCTION COMPANY, Pittsburg, Pa.
Samples of Carborundum products.

CROCKER-WHEELER ELECTRICAL COMPANY, Denver, Colo.
475 blue prints; pictures of motors and generators.

GENERAL ELECTRIC COMPANY, Schenectady, N. Y.
Case of incandescent lamps, illustrating the different stages of manufacture.
Picture of steam turbine and generator.

WESTERN ELECTRIC COMPANY, Chicago, Ill.
Collection of insulated wire and cable samples.

UNION CARBIDE COMPANY, Niagara Falls, N. Y.
Collection of products.

THE LUNKENHEIMER COMPANY, Cincinnati, Ohio.
Sectioned samples of regrinding globe valve, injector, gate valve and senior lubricator.

NERNST LAMP COMPANY, Pittsburg, Pa.
Nernst Lamp.

FARBENFABRIKEN OF EBENFELD CO., New York.
Samples of coal-tar dyes.

NORTON EMERY WHEEL COMPANY, Worcester, Mass.
Twenty samples of products.

H. A. METZ, 122 Hudson St., New York.
Samples of coal-tar dyes.

MAX BOEHMER, Mining Engineer, Denver, Colo.
Model of mine.

DR. HERMAN FLECK, Golden, Colo.
Bucking board and muller for Assay Laboratory.

ROBINS CONVEYING BELT COMPANY, New York.
Samples of conveying belt.

NEW YORK CENTRAL AND HUDSON RIVER R. R.
Four pictures of the New York Central Lines.

PRIMOS CHEMICAL COMPANY, Primos, Pa.
Cabinet of rare metals. Tungsten metal.

WARREN BROTHERS COMPANY, New York.
Samples of biluthic pavement.

DEUTSCHE UNTERRICHTS AUSSTELLUNG, Louisiana Purchase Exposition.
Collection of fine and rare chemicals.

GERMAN POTASH SYNDICATE, Strassfurt, Germany.
Samples of raw and finished products.

HENDRIE & BOLTHOFF MANUFACTURING CO., Denver, Colo.
Picture of Murray Corliss engine.
Picture of Marsh general service pump.
Card Concentrating Table.

THE W. S. TYLER COMPANY, Cleveland, Ohio.
Sample board of wire cloth and mining screens.

RAPID-ECONOMY STAMP MILL COMPANY, San Francisco, Cal.
Model of Richards Rapid-Economy stamp mill.

THE BROWN HOISTING MACHINERY COMPANY, Cleveland, Ohio.
Four pictures of industrial plants.

KUEFFEL AND ESSER, New York.
Large slide rule.

FLINT-LOMAX ELECTRICAL AND MANUFACTURING COMPANY, Denver, Colo.
Standard test specimens in cast aluminum and bronze.

UNIVERSITY OF PENNSYLVANIA ALUMNI.
Set of University views.

PORTLAND CEMENT COMPANY, Portland, Colo.
Cement for cement laboratory.

A. W. FABER COMPANY, New York.
Large slide rule.

WESTERN CEMENT SELLING COMPANY, Denver, Colo.
Iola cement for cement laboratory.

American Gas Furnace Company, New York.
Two assay cupel furnaces.
One Reichhelm pressure blower.
One smelting furnace.
Four muffles.

F. W. Thompson, Denver, Colo.
One Thompson Multiple Rider Carrier.

Hammon and Martin, Ouray, Colo.
One Martin automatic plumb bob.

William Hoskins and Company, Chicago, Ill.
One gasoline furnace.

Jenkins Brothers, Chicago, Ill.
Assortment of globe valves, pump valves, discs, packing, check valves, and gasket tubing.

The Lunkenheimer Company, Cincinnati, Ohio.
Sectioned paragon lubricator, Mars lubricator, and rotary gauge cock.

General Electric Companyy, Schenectady, N. Y.
Framed pictures of the Schnectady works and of the N. Y. C. 100-ton 3000 H. P. Electric Locomctive.

Morse Brothers Machinery and Supply Company, Denver, Colo.
Model of Corliss engine.

Allis-Chalmers Company, Chicago, Ill.
Six framed pictures: "Big Reliable" engine and generator; connecting rod shops; Manhattan Railway bridge; lead furnace; Overstorm table; and Gates rock and ore breaker.

Western Valve Company, Chicago, Ill.
Assortment of sectioned valves; ordinary and flanged coupling.

Prof. C. W. L. Filkins,
Five photograph printing frames.

The Blaisdell Company, Los Angeles, Cal.
Pictures of excavators at the El Oro Mining and Railway Company, El Oro, Mexico.

THE HANCOCK INSPIRATOR COMPANY, Chicago, Ill.
One sectioned Hancock Inspirator.

THE WESTINGHOUSE COMPANY. Pittsburg, Pa.
Five pictures of Westinghouse installations

E. P. ARTHUR, Cripple Creek, Colo.
Mining map of Cripple Creek District.

CASTNER-ELECTROLYTIC ALKALI COMPANY, Niagara Falls, N. Y.
Samples of chemical products.

JUDGE N. F. CLEARY, New York, N. Y.
Model of El Panuco Mine, Coahuila, Mexico.

JOSEPH T. RYERSON & SON, Chicago, Ill.
Model of Morrison corrugated boiler.

DETROIT LUBRICATOR COMPANY, Detroit, Mich.
One standard lubricator.

AMERICAN LUBRICATOR COMPANY, Detroit, Mich.
One U. S. automatic injector.

D. W. BRUNTON, Denver, Colo.
One Brunton Pocket Transit.

BULLOCK ELECTRIC MFG. COMPANY, Cincinnati, Ohio.
Sample board of construction parts.

WATSON AND McDANIEL COMPANY, Philadelphia, Pa.
One McDaniel Improved Steam Trap.

JEFFERY MANUFACTURING COMPANY, Columbus, Ohio.
Three framed pictures of rock drills.

DENVER FIRE CLAY COMPANY, Denver, Colo.
Four Case gasoline furnaces.
One Iler cupel machine.

CHAPMAN VALVE MANUFACTURING COMPANY, Indian Orchard, Mass.
Four sectioned valves.

UNION PACIFIC RAILROAD COMPANY.
Six framed pictures.

McKIERNAN DRILL COMPANY, New York, N. Y.
One rock drill with column.

Hardsocg Wonder Drill Company, Ottumwa, Iowa.
Rock drill, with column and bits.

Edward G. Stoiber, Denver, Colo.
One Hildebrand mining transit.

Colorado Midland Railway Company.
Two framed pictures.

New York Belting and Packing Company, New York, N. Y.
Samples of packing and belting.

Chicago and Northwestern Railway Company.
Five framed pictures.

American Steam Pump Company, Battle Creek, Mich.
Three valves.
Sectioned pump.
One framed picture.

Hotel Colorado, Glenwood Springs, Colo.
One framed picture.

Wisconsin Bridge and Iron Company, Chicago, Ill
Blue prints of coal tipples.

Garlock Packing Company, Denver, Colo.
Wall cabinet of various packings.

C. H. Shaw Pneumatic Tool Company, Denver, Colo.
One rock drill complete.

Weston Electrical Instrument Company, Newark, N. J.
Exhibition case of parts.

Chicago, Burlington and Quincy R. R. Co.
Two framed pictures.

A. E. Lindrooth, Shubart and Company, Denver, Colo.
Four framed pictures from the Goodman Mfg. Co.
Two framed pictures from the Ridgway Dynamo and Engine Company.
One framed picture from the Link-Belt Machinery Co.

The J. George Leyner Engineering Company, Denver, Colo.
One 12x14 two-stage air compressor.

THE TRUAX MANUFACTURING COMPANY, Denver, Colo.
John T. Plummer, Prop.
Truax Patent Automatic ore car.

SULLIVAN MACHINE COMPANY, Chicago, Ill.
One air drill, complete.

THE BABCOCK AND WILCOX COMPANY, New York, N. Y.
Six framed pictures.

CONTINENTAL COLOR AND CHEMICAL COMPANY, New York, N. Y.
Samples of colors.

KEASBEY AND MATTISON COMPANY, Amber, Pa.
Case of samples.

JONES AND LAUGHLIN STEEL COMPANY, Pittsburg, Pa.
William C. Moreland, Sec'y.
Three framed pictures.

INGERSOLL-RAND COMPANY, New York, N. Y.
One Ingersoll-Sergeant drill, complete.

TRENTON IRON WORKS, Denver, Colo.
Col. R. D. Seymour, General Agent.
Aerial tram.

WABASH RAILROAD,
P. Hitchcock, General Agent.
Framed picture.

COLORADO BUREAU OF MINES,
E. L. White, Commissioner.
Five cases for minerals.

JOHN W. FINCH, State Geologist, Denver, Colo.
Mine model.

DENVER, NORTHWESTERN AND PACIFIC RAILWAY.
Pictures of scenery on the Moffat Road.

HARRY M. RUBEY, Golden, Colo.
Mounted eagle.

RAND-INGERSOLL COMPANY, New York, N. Y.
Temple-Ingersoll electric drill.

Mr. Simon Guggenheim, Denver, Colo.
"Mucho Quidado," oil painting by John A. Howland.

T. Dwight Smith, Denver, Colo.
Native Copper and Cylindrite.

Thos. F. Daly, Denver, Colo.
Twenty photographs of the Calumet and Hecla mining properties.

John Geisel, Denver, Colo.
Fluorite Crystals.

Chas. J. Adami, Butte, Montana.
Copper ores from the Gagnon mine.

William Watson, Denver, Colo.
Collection of ores and minerals.

Fred E. Field, Beatty, Nevada.
Ruby silver.

ENROLMENT OF STUDENTS.

CLASS OF 1907.

SENIORS.

OFFICERS.

President, C. G. WARFEL.
Vice President, A. G. WOLF.
Secretary, PIERCE BARKER.
Treasurer, R. E. KNIGHT.

	Course	
Armington, H. C.	Min.	*Leadville, Colo.*
Barker, Pierce	Met.	*Philadelphia, Pa.*
Bastanchury, G. A.	Min.	*Fullerton, Cal.*
Brandt, A. R.	Min.	*Denver, Colo.*
Colburn, C. L.	Min.	*Denver, Colo.*
Corson, N. G.	Min.	*Del Norte, Colo.*
Ellis, T. P.	Min.	*Denver, Colo.*
Emens, R. B.	Met. & Min.	*Victor, Colo.*
Filteau, C. A.	Min.	*Idaho Springs, Colo.*
Friedhoff, W. H.	Met. & Min.	*Denver, Colo.*
Geisel, C. R.	Min.	*Denver, Colo.*
Golden, J. P. B. S. University of Nebraska.	Min.	*O'Neill, Neb.*
Gow, P. A.	Min.	*Golden, Colo.*
Grommon, P. D.	Met.	*Denver, Colo.*
Hills, L. P. B. S. Ohio Wesleyan University.	Min.	*Durango, Colo.*
Hollis, D. D.	Min.	*Silverton, Colo.*
Howat, A. M.	Min.	*Salt Lake, Utah*
Isom, E. W.	Min.	*Chicago, Ill.*
Kenner, A. R. Armour Institute of Technology.	Min.	*Kenilworth, Il.*
Knight, R. E	Met.	*Denver, Colo.*
Krueger, G. S.	Min.	*Longmont, Colo.*
Lannon, F. P., Jr.	Met.	*Pueblo, Colo.*
Martin, J. A.	Min.	*Golden, Colo.*
Moore, C. F.	Min.	*Denver, Colo.*

	Course	
Moore, G. P.	Min.	*Winsted, Conn.*
Nash, A. M. B. S. Kansas State Agricultural College.	Min.	*Golden, Colo.*
Norton, A. C.	Min.	*La Junta, Colo.*
Parsons, F. H. A. B. Wesleyan University.	Min.	*Paterson, N. J.*
Phelps, W. B. B. S. St. Vincent College.	Min.	*Los Angeles, Cal.*
Quayle, T. W.	Met.	*Denver, Colo.*
Ross, G. M.	Met.	*Golden, Colo.*
Shaver, F. J.	Min.	*San Jacinto, Cal.*
Stotesbury, H. W.	Min.	*Leadville, Colo.*
Warfel, C. G.	Min.	*Golden, Colo.*
White, J. L.	Met. & Min.	*Denver, Colo.*
Wolf, A. G.	Min.	*Golden, Colo.*

CLASS OF 1908.

JUNIOR.

OFFICERS.

President, R. B. ELDER.
Vice President, I. J. DILTS.
Secretary, C. E. LESHER.
Treasurer, R. M. WHEELER.

	Course	
Adams, J. H. B. S. Ag. and Mech. College, Oklahoma; A. B. University of Kansas.	Met.	*Steamboat Springs, Colo.*
Anfenger, M. B.	Min.	*Denver, Colo.*
Blackburn, Ward	Min.	*Denver, Colo.*
Block, G. E.	Min.	*Prescott, Ariz.*
Boyd, J. T.	Min.	*Denver, Colo.*
Brinker, A. W.	Min.	*Denver, Colo.*
Brown, C. L.	Min.	*Golden, Colo.*
Brugger, A. E. University of Michigan.	Met.	*Columbus, Neb.*
Bryan, R. R.	Met.	*Denver, Colo.*
Buell, A. W.	Min.	*Evergreen, Colo.*
Chedsey, W. R.	Min.	*Denver, Colo.*
Clapp, L. P. Worcester Polytechnic Institute.	Min.	*Denver, Colo.*
Cline, S. F. Leland Stanford Jr. University.	Min.	*Mansfield, O.*
Crawford, W. O.	Min.	*Santa Monica, Cal.*
Curtis, L. P.	Min.	*Littleton, Colo.*
De Camp, W. V.	Min.	*Denver, Colo.*
Dilts, I. J.	Met.	*Ft. Collins, Colo.*
Doyle, D. B. A. B., A. M., Princeton University.	Min.	*Pittsburg, Pa.*
Dunlevy, F. S.	Met.	*Denver, Colo.*
Elder, R. B.	Met.	*Denver, Colo.*
Ellsworth, A. C. B. S. University of Chicago.	Min.	*Chicago, Ill.*
Evans, Willis	Met.	*Golden, Colo.*
Everest, H. A. B. S. University of Oklahoma.	Min.	*Oklahoma City, Okla.*
French, B. J. A. B., University of Denver.	Min.	*Golden, Colo.*

	Cours	
French, Sidney W.	Met.	*Denver, Colo.*
Frick, F. F.	Met.	*Peru, Indiana*
Goe, H. H.	Met.	*Colorado Springs, Colo.*
Hammond, H. W.	Min.	*Syracuse, N. Y.*
Leland Stanford Jr. University.		
Harris, Morrison	Min.	*Philadelphia, Pa.*
B. S. in C. E., University of Pennsylvania.		
Holderer, G. B.	Min.	*Denver, Colo.*
University of Denver.		
Houseman, E. G	Min.	*Grand Rapids, Mich.*
A. B., University of Michigan.		
Hubbard, J. V.	Min.	*Golden, Colo.*
Hull, C. B.	Met.	*Idaho Springs, Colo.*
Hunt, H. V. D.	Met.	*Baltimore, Md.*
Baltimore Polytechnic Institute.		
Hynes, B. D.	Min.	*Elgin, Ill.*
B. S., Virginia Polytechnic Institute.		
Ireland, C. B.	Met. & Min.	*Golden, Colo.*
Jacques, H. L.	Met.	*Denver, Colo.*
Johnson, B. M.	Met. & Min.	*Denver, Colo.*
University of Minnesota.		
Johnston, W. M.	Met. & Min.	*Pensacola, Fla.*
Hamline University.		
Jones, I. P.	Min.	*Naco, Ariz.*
Armour Institute of Technology.		
Jones, W. A., Jr.	Min.	*Ware Neck, Va.*
Princeton University.		
Kilgour, M. H.	Min.	*London, Eng.*
Central Technical College, London, Eng.		
Knight, H. G.	Met.	*Akron, O.*
B. S., Buchtel College.		
Knowles, B. W.	Min.	*Denver, Colo.*
Langrall, C. A.	Met.	*Baltimore, Md.*
Baltimore Polytechnic Institute.		
Lesher, C. E.	Met.	*La Junta, Colo.*
Lewis, W. M.	Met.	*Georgetown, Colo.*
University of Minnesota.		
Link, K. G.	Met.	*Denver, Colo.*
Lowell, J. B.	Met.	*Worcester, Mass.*
Worcester Polytechnic Institute.		
Lyon, C. A.	Min.	*Newark, N. J.*
A. B., Princeton University.		
Macbeth, Gordon F.	Min.	*Denver, Colo.*
Ph. B., Sheffield Scientific School.		
Maddux, R. H.	Min.	*Golden, Colo.*
Murch, C. H.	Min.	*Denver, Colo.*
University of Denver.		
Nevin, B.	Met.	*Porto Rico*
Brooklyn Polytechnic Institute.		
Page, L. C.	Min.	*Norfolk, Va.*

	Course	
Reno, C. A.	Min.	*Manitou, Colo.*
Roberts, R. C.	Min.	*Boulder, Colo.*
	B. S., University of Colorado.	
Root. C. D.	Min.	*Denver, Colo.*
Sandusky, S. C.	Met. & Min.	*Salida, Colo.*
Schoeller, W. R.	Min.	*Antwerp, Belgium*
	University of Greifswald, Germany.	
Taylor, R. M.	Min.	*Golden, Colo.*
Vinal, E. L.	Met. & Min.	*Denver, Colo.*
	University of Minnesota.	
Waite, J. W.	Min.	*Denver, Colo.*
	Ph. B., Adelbert College.	
Weinig, A. J.	Met.	*Durango, Colo.*
	University of Colorado.	
Wheeler, R. M.	Min.	*Denver, Colo.*
	University of Denver.	
White, D. A.	Met.	*Chicago, Ill.*

CLASS OF 1909.

SOPHOMORE.

OFFICERS.

President, H. A. KRUEGER.
Vice President, PAUL NEER.
Secretary, V. H. WHIPPLE.
Treasurer, J. J. WEISZ.

Allen, L. M., Jr. .... *Westwood, N. J.*
Babson, G. L. .... *Seward, Neb.*
University of Nebraska.
Baker, M. H. .... *Denver, Colo.*
Benjovsky, T. .... *Del Norte, Colo.*
Bennitt, J. S. .... *Jersey City, N. J.*
Stevens Institute of Technology.
Bradford, A. H. .... *Placentia, Cal.*
Bradford, J. S. .... *Denver, Colo.*
Brigham, E. D., Jr .... *Glencoe, Ill.*
Sheffield Scientific School. Yale University.
Brueggemann, F. .... *Denver, Colo.*
Brunton, F. K. .... *Denver, Colo.*
University of Wisconsin.
Bunger, M. E. .... *Edgewater, Colo.*
University of Denver.
Canning, W. E. .... *Council Bluffs, Ia.*
Carpenter, C. H. .... *Denver, Colo.*
University of Denver.
Chambers, Horace .... *Nashville, Tenn.*
Crosley, A. B. .... *Denver, Colo.*
Darroch, J. I. .... *Livingston, Mont.*
Donaldson, John .... *Minneapolis, Minn.*
Massachusetts Institute of Technology.
Dyer, C. E. .... *Golden, Colo.*
Emrich, C. T. .... *Golden, Colo.*
Colorado College.
Enriquez, E. W. .... *Chihuahua, Mexico*
Notre Dame University.
Feldman, S. A. .... *Denver, Colo.*
Ferris, H. A. .... *Aspen, Colo.*
Fitz Gerald, R. P. .... *Roswell, N. M.*
University of Oregon.

Geary, R. E. .... *Portland, Ore.*
University of Oregon.
Graham, T. B. .... *Nashville, Tenn.*
Vanderbilt University.
Griffith, J. R. .... *Denver, Colo.*
University of Denver.
Hall, S. D. .... *Denver, Colo.*
Hallett, A. F. .... *Denver, Colo.*
Hammond, W. L. .... *Saguache, Colo.*
Hansen, C. L. .... *Placentia, Cal.*
Harwood, T. F. .... *Bloomington, Ill.*
Hooper, R. W. .... *New York City, N. Y.*
Yale University.
Hurlburt, C. M. .... *Portland, Ore.*
University of California.
Kelso, D. C. .... *Edgewater, Colo.*
Krowell, A. W. .... *Chicago, Ill.*
Kruger, H. A. .... *Denver, Colo.*
Ledbetter, R. A. .... *Elizabethtown, Ill.*
Washington University.
Lesh. H. B. .... *Oak Park, Ill.*
Linderfelt, R. J. .... *Golden, Colo.*
McClelland, J. V. .... *Denver, Colo.*
Colorado College.
Mathez, Forrest .... *Denver, Colo.*
Merrill, Monroe .... *Hollywood, Cal.*
University of Southern California.
Miller, DeMont G. .... *Los Angeles, Cal.*
University of Southern California.
Neer, Paul .... *Golden, Colo.*
Nordenholt, G. D., Jr. .... *Oak Park. Ill.*
University of Wisconsin.
Norris, D. R. .... *Denver, Colo.*
Patrick, W. B. .... *Denver, Colo.*
Princeton University.
Phelps, H. D. .... *Denver, Colo.*
University of Wisconsin.
Peirce, C. D. .... *Denver, Colo.*
Rambo, W. C. .... *Morristown, Pa.*
Ristedt, E. J. .... *Idaho Springs, Colo.*
Roehrig, G. F., Jr., ... *Denver, Colo.*
Ronan, C. L. .... *Albany, N. Y.*
Rensselaer Polytechnic Institute.
Rowe, H. L. .... *Elgin, Ill.*
University of Illinois.
Rush, J. M. .... *New Carlisle, Ind.*
Purdue University.
Russell, D. O. .... *London, Eng.*
Sacket, B. L. .... *Newark, N. J.*
Schafer, Louis .... *Lake City, Colo.*

Schaffer, B. L. University of Colorado.	*Del Norte, Colo.*
Silver, L.	*Aspen, Colo.*
Smart, F. B.	*Santa Barbara, Cal.*
Soupcoff, S. M. Allegheny College.	*Pittsburg, Pa.*
Strohl, G. F.	*Greeley, Colo.*
Swezey, R. B. University of Illinois.	*Hinsdale, Ill.*
Taggart. O. R.	*Denver, Colo.*
Tennant, M. R. University of Denver.	*Fergus Falls, Minn.*
Wasley, W. A.	*Greeley, Colo.*
Watson, G. P.	*Greeley, Colo.*
Weir, J. A.	*Denver, Colo.*
Weizz, J. J.	*Chicago, Ill.*
Whipple, V. H. Armour Institute of Technology.	*Chicago, Ill.*
Weinhober, W. H. Cornell University.	*Chicago, Ill.*
Wilett, R. R.	*Golden, Colo.*
Wilson, D. M.	*Golden, Colo.*

CLASS OF 1910.

FRESHMEN.

Officers.

President, Thos. M. Skinner, Jr.
Vice President, S. R. Brown, Jr.
Secretary, M. H. Showman.
Treasurer, A. K. Rose.

Adams, J. C.	*Steamboat Springs, Colo.*
Annell, Eric G.	*Dundee, Ill.*
Ashley, C. S., Jr.	*Boston, Mass.*
Avery. H. C.	*Syracuse, N. Y.*
Baker, H. W.	*Seattle, Wash.*
Barbour, A. R.	*Edgewater, Colo.*
Barnett, W. E. W.	*Denver, Colo.*
Barry, V. T. University of Kansas.	*Golden, Colo.*
Blight, W. T.	*Golden, Colo.*
Brann, E. R.	*Warren, Pa.*
Brown, S. R., Jr.	*Montrose, Colo.*
Brown, W. R.	*Chicago, Ill.*
Bruderlin, E. J.	*Denver, Colo.*
Calvert, C. E.	*Whitewater, Wis.*
Campbell, K. P.	*Boulder, Colo.*
Carman, J. B.	*Denver, Colo.*
Carpenter, P. H. Pennsylvania State College.	*Sharon, Pa.*
Cary, W. P.	*Salida, Colo.*
Charles, A. J.	*Denver, Colo.*
Christie. L. J.	*Quincy, Ill.*
Clarke, M. W.	*Mayer, Ariz.*
Clausen, S. J., Jr.	*Clear Lake, Ia.*
Coughlan, E. P.	*North Dartmouth, Mass.*
Crawford, R. O.	*Philadelphia, Pa.*
Currens, W. W.	*Denver, Colo.*
Decker, H. P.	*Niles, O.*
DeWolf. Clark F.	*Findlay, O.*
Dorland, H. E.	*Chicago, Ill.*
Dunn, Wm.	*Dorchester, Mass.*

Farrar, Russell J. University of Oregon.	*Salem, Ore.*
Findley, Thos. J.	*Mattoon, Ill.*
Finley, R. B.	*Craig, Colo.*
Fritch, F. G. O.	*Colorado Springs, Colo.*
Gehman, Lester	*Golden, Colo.*
George, S. L.	*Bellevue, Idaho*
Geringer, G. T. St. Xavier College.	*Cincinnati, O.*
Gilbert, J. I.	*Edgewater, Colo.*
Glasgow, C. M.	*St. Louis, Mo.*
Goldberg, L. B.	*Kansas City, Mo.*
Graves, T. A.	*Olean, N. Y.*
Gregory, A. E.	*Coversham, Eng.*
Hamill, W. A.	*Woodstown, N. J.*
Hamilton, W. J. University of Southern California.	*Goleta, Cal.*
Hartman, W. J.	*Pueblo, Colo.*
Harvey, J. V.	*Sioux City, Ia.*
Hastings, J. L.	*Denver, Colo.*
Hayden, H. P.	*Beaumont, Tex.*
Hennig, J. R.	*Casey, Ill.*
Hilton, H. J.	*Denver, Colo.*
Hotchkiss, C. B.	*Denver, Colo.*
Howe, C. W.	*Golden, Colo.*
Howe, F. B.	*Colorado Springs, Colo.*
Hoyt, M. R.	*Golden, Colo.*
Jackson, R. B.	*Denver, Colo.*
Jacobs, H. J.	*Denver, Colo.*
Johnson, H. G.	*Chicago. Ill.*
Jones, E. F.	*Las Esperanzas, Coahuila, Mexico*
Jones, H. H.	*Temple, Tex.*
Jones, V. K.	*Denver, Colo.*
Juchem, H. H.	*Arvada, Colo.*
Keith, L. P.	*Golden, Colo.*
Kendall, J. D.	*Washington. D. C.*
Kling, D. W.	*Marion, O.*
Kopke, N. E.	*Beaumont, Tex.*
Labram, F. W.	*Chicago, Ill.*
Laughlin, S. W.	*Golden, Colo.*
Lee, Frank W., Jr.,	*Denver, Colo.*
Lee, George M.	*Boise, Idaho.*
LeMarr, J. R.	*Rock Springs, Wyo.*
Linderfelt, T. C.	*Golden, Colo.*
McCallum, Jean	*Ft. Collins, Colo.*
McKay, G. S.	*Townsend, Mont*
Major, F. A.	*Creede, Colo.*
Matheson, K. H.	*Denver, Colo.*

Mattice, Eugene	*Pueblo, Colo.*	
May, A. L.	*Beaver Falls, Pa.*	Geneva College.
Mullan, H. D.	*Sioux City, Ia.*	Iowa State College.
Neece, O. J.	*Macomb, Ill.*	
Neef, Louis	*Denver, Colo.*	
Neer, Lee	*Golden, Colo.*	
Nelson, J. W.	*Denver, Colo.*	
Oram. C. F.	*Golden, Colo.*	
Osgood, S. W.	*Denver, Colo.*	
Owens, J. A.	*Salt Lake, Utah.*	
Patterson, A. L.	*Pueblo, Colo.*	
Perry, C. L.	*Belleville, Kas.*	
Peterson, George	*Brush, Colo.*	
Pilger, T. F.	*Loup City, Neb.*	
Pinger, P. J.	*Golden, Colo.*	
Pullen, L. L.	*Golden, Colo.*	Michigan College of Mines.
Purdy, I. A.	*Golden, Colo.*	Alma College.
Raedel, L. W.	*Denver, Colo.*	
Ralston, E. L.	*Dewey, Mont.*	
Reasoner, R. B.	*Colorado Springs, Colo.*	
Reed, Sydney	*Denver, Colo.*	
Rittenhouse, George, Jr.,	*Plainfield, N. J.*	
Roberts. H. M.	*Denver, Colo.*	
Rose, A. K.	*Arvada, Colo.*	
Rupert, A. M.	*Geneva, N. Y.*	
Salisbury, G. W.	*Whitewater, Wis.*	
Saxton, F. B.	*Pueblo, Colo.*	
Shapiro, Louis	*Colorado Springs, Colo.*	
Showman, H. M.	*Denver, Colo.*	
Skavlen, H. G.	*Janesville, Wis.*	
Skinner, Thos. M., Jr.	*Denver, Colo.*	
Spring, Archer	*Salem, Mass.*	
Stovell, John	*Colorado Springs, Colo.*	
Swainson, O. W.	*Denver, Colo.*	
Thorpe, Herbert	*Montclair, Colo.*	
Turpie, Frank	*North Platte, Neb.*	
Tweeddale. T. W.	*Rugby, Colo.*	
Waters, T. E. G.	*Denver, Colo.*	
Wells, Lucius S.	*Grand Junction, Colo.*	
West, J. R.	*Greeley, Colo.*	
Whitehurst, J. W.	*Sailda, Colo.*	
Wiliams, Thos. T.	*Trinidad, Colo.*	University of Illinois.
Wood, S. G. J.	*Pittsfield, Mass.*	
Woodburn, O.	*Denver, Colo.*	Missouri School of Mines.

SUMMARY.

Seniors	36
Juniors	66
Sophomores	74
Freshmen	118
Total	294

THE ALUMNI.

Abel, Walter D., '06 .... *Landore, Idaho*
Ladd Metals Co.

Adami, Charles J., '99 .... *Cable Mont.*
Superintendent, Cable Mine

Adams, Charles, '04 .... *Yerington, Nevada*
Superintendent, Spoagy Mine.

Adams, Wilber E., '00 .... *Lewiston, Idaho*
Mining Engineer and U. S. Deputy Mineral Surveyor.

Aldrich, Harold W., '06 .... *Boulder, Colo.*

Allen, Carl A., '05 .... *Baco y Hijos Choix, Sinaloa, Mex.*
Assistant to Mining Expert.

Allen, Maynard C., '06 .... *Butte, Mont.*
Mining Engineer, Boston and Montana C. & S. Mining Co.

Aller, Frank B., '92 .... *Antofagasta, Chili, South America.*
Agent A. S. & R. Co.

Ambrosius, Carl E., '88 .... *Guanacevi, Durango, Mexico*

Anderson, Axel E., '04 .... *Chicago, Ill.*
With R. W. Hunt & Co.

Anderson, Neil A., '02 .... *Frisco, Cactus, Co., Utah*
Surveyor.

Arthur, Edward P., '95 .... *Cripple Creek, Colorado*
U. S. Deputy Mineral Surveyor.

Atkins, Horace H., Jr., '94 .... *Mayer, Arizona*
Chemist, Rigby M. & R. Co.

Atkinson, Walter J., '96 .... *Chicago, Illinois*
Civil Engineer.

Atwater, Maxwell W., '01 .... *Helena, Montana*
Gold Block.

Austin, Arthur, '05 .... *706 Locust Streetfi Anaconda, Mont.*
Washoe Smelter, Anaconda Copper Mining Co.

Badger, Herbert E., '02 .... *819 17th St., Greeley, Colo.*
Civil, Hydraulic and Mining Engineer.

Badgley, Charles W., '06 .... *1730 Franklin St., Denver, Colo.*
Assistant Chemist, A. S. & R. Co.

Bailey, E. W., '05 .... *Millers, Nev.*
Tonopah Mining Co.

Ball, Max W., '06 .... *Rawlins, Wyo.*
U. S. Geological Survey.

Barbour, Percy P., '98 .... *Idaho Springs, Colo.*
Stevens-Barbour & Co., Engineers.

Barensheer, William J., '96 .... *Los Angeles, Cal.*
Mining Engineer.

Barker, Franklin L., '06 .... *Leadville, Colo.*
Western Mining Co.
Barnes, Corrin, '96 .... *1843 Lawrence St., Denver, Colo.*
Assayer.
Barron, Chauncey F., '02 .... *El Paso, Texas*
Bartholomew, Tracy, ''06 .... *Flat River, Mo.*
Federal Lead Co.
Beeler, Henry C., '96 .... *State Capitol, Cheyenne, Wyo.*
State Geologist.
Bell, Charles Norman, '06 .... *946 Equitable Building, Denver, Colo.*
Champion-Trio M. & M. Co.
Bellam, Henry L., '89 .... *Saint Clair, Nev.*
Assistant Engineer, U. S. Reclamation Service.
Benwell, George A., Jr., '00 ...... *1337 Josephine St., Denver, Colo.*
Mining Engineer.
Bergh, John E., '02 .... *Bingham Canyon, Utah*
Engineer Bingham Con. M. & S. Co.
Berry, Albert, '05 .... *339 Riverside Ave., Spokane, Wash.*
Bertschy, Perry H., '98 .... *Deadwood. South Dak.*
Bishop, Raymond, '01 ....
Deceased.
Blumenthal, Emil E., '98 .... *Phillipsburg, Mont.*
Chemist and Assayer.
Bowie, James W., '94 .... *Golden, Colo.*
Bowman, Frank C., '01 .... *Smuggler, Colo.*
Superintendent, Japan-Flora Mines & Tunnel Co.
Bradley, Joseph M., '01 .... *La Plata, Colo.*
Empire G. M. Co.
Breed, Charles F., '01 .... *Denver, Colo.*
Brinker, Arthur C., '01 .... *Ouray, Colo.*
Metallurgist, Camp Bird Mine, Ltd.
Brown, John B., '06 ..*Cerro Prieto, via Magdalena. Sonora, Mexico*
Black Mountain Mining Co.
Brown, Norton H., '92...................... *Idaho Springs, Colo.*
U. S. Deputy Mineral Surveyor.
Brown, R. L., '05 ....*1645 Colorado Ave., Colorado Springs, Colo.*
Golden Cycle Mill.
Bruce, Harry F., '00................................ *Tonopah, Nev.*
Electro-Geodetic Mining Co.
Bruce, James L.. '01 .... *Flat River, Mo.*
Chief Engineer, Federal Lead Co.
Bruce, Stuart S., '99 .... *Denver, Colo.*
Assistant Engineer, Colorado Department A. S. & R. Co.
Brunel, Rene L, '06 .... *Butte, Mont.*
Gagnon Mine.
Buck, Arthur H., '97 ....
Bucher, John William, '09 .... *1727 Champa St., Denver, Colo.*
Budrow, William B., '92 .... *Aguas Calientes, Mexico*
Metallurgist, A. S. & R. Co.
Bumsted, Edward J., '01 .... *Valardena, Durango, Mexico*
Burlingame, Walter E., '01........ *1736 Lawrence St.. Denver, Colo.*
Chemist and Assayer.

Busey, A. P., Jr., '05........................ *Box E, Creede, Colo.*
East Willow Mining Co.
Bussey, Edwin E., '87 ...... *137 Florissant St., Cripple Creek, Colo.*
Butler, G. Montague, '02.......................... *Golden, Colo.*
Instructor in Geology and Mineralogy, Colorado School of Mines.
Canning. Herbert A., '97 .... *Flat River, Mo.*
Assistant Superintendent, Federal Lead Co.
Carney, Hugh J., '04 .... *Flat River, Mo.*
Foreman, Diamond Drill Department, Federal Lead Co.
Carstarphen, F. C., '05 ...... *221 McPhee Building, Denver, Colo.*
Hewitt & Carstarphen, Mining and Constructing Engineers.
Chamberlin, W. O., '05.......... *El Oro, State of Mexico, Mexico*
Esperanza Mining Co.
Chandler, John W., '01 .... *Coulterville, Mariposa Co., Cal.*
Superintendent, Champion Mine.
Chapman, Thomas L., '06 .... *Goldfield, Nev.*
Assistant Engineer, Marshall-Ellis Investment Co.
Charles, Lavern J., '02 .... *Box 834, North Yakina, Wash.*
Assistant Engineer, U. S. Reclamation Service.
Christensen, Walter, '02 .... *Kimberly, Utah*
Superintendent, Series Con. G. M. M. & C. Co.
Church. Myron J., '98 .... *935 30th St., Milwaukee, Wis.*
Davis Manufacturing Co.
Clark, George B., '01 .... *Pueblo, Colo.*
Assayer, Eilers Plant, A. S. & R. Co.
Clark, Winfred N., '98 .... *Victor, Colo.*
Superintendent, Pueblo and Suburban Traction and Lighting Co.
Coghill, Will H.. '03 .... *Joplin, Mo.*
Mining Engineer, United Zinc Companies.
Cohen, Louis, '97 .... *417 Jackson Building, Denver, Colo.*
Mining and Metallurgical Engineer.
Cole, Burt, '92 .... *Tecumseh. Ala.*
Superintendent, Tecumseh Iron Co.
Coleman, Prewitt R., '03 .... *Denver, Colo.*
Collbran, Arthur H., '02 .... *Seoul, Korea*
Superintendent, Suan Mines, Korean Syndicate, Ltd.
Collins, Philip M., '93 .... *Canon City, Colo.*
U. S. S. Co.
Collins, Shrive B., '01 .... *Amethyst Postoffice, Creede. Colo.*
Mining Engineer.
Comstock, Charles W., '90 ..... *213 Boston Building, Denver, Colo.*
Civil and Mining Engineer.
Cory, J. J., '05 .... *Ellamar, Alaska*
Mining Engineer, Ellamar Mining Co.
Corry, Arthur V., '98 .... *23 Silver Bow Block, Butte, Mont.*
Mining Engineer.
Cox. Augustus D., '93 .... *Box 144, Palmetto, Nev.*
Cox, W. Ray, '02......................... *Box 717, Goldfield, Nev.*
Mining Engineer.
Craigue, William H., '89......................... *Gilmour, Idaho*
Gilmour Mining Co.
Cramer, Curtis P., '99 .... *Fierro, New Mexico*
Mining Engineer, C. F. & I. Co.

Crowe, Thomas B., '00 .... *Colorado Springs, Col.*
Portland Mill.

Crow, Wade L., '01 ....
Deceased.

Cuno, A. F., '05 .... *Garfield, Utah*
Assayer, Garfield Smelter.

D'Arcy, R. L., '05 .... *250 So. 15th St., Denver, Colo.*

Davey, William R., '98 .... *Lake City, Colo.*

Davis, Carl R., '95 .... *Rossland, British Columbia*
Superintendent, War Eagle and Center Star Mining Co.

Davis, Gilbert L., '99 ....*816 Majestic Building, Denver, Colo.*
Assistant Engineer, Denver City Tramway Co.

DeCou, Ralph E., '01 ....*Mammoth, Ariz.*
Mining.

De Sollar, Tenney C., '04 ....*Baker City, Ore.*
Mining Engineer and Assayer, United Elkhorn Mining Co.

Devinney, George V., '03 .... *Denver, Colo.*
Construction Department, Colorado Telephone Co.

Dockery, L. A., '95 ....*Chihuahua, Mexico*

Dollison, James E., '998 ....*Alma. Colo.*
Surveyor and Proprietor of the Alma Assay Office.

Dow, William G., '06 .... *Scottsbluff, Neb.*
U. S. Reclamation Service.

Downer, Roger H., '01 ....*Box 175, Goldfield, Nev.*
Downer Brothers, Assayers and Chemists.

Draper, Marshall D., '97 ......*215 McPhee Building, Denver, Colo*
Mining Engineer, American Exploitation Co.

Drescher, Frank M., '00...................... .. *Prescott, Ariz.*
Mining Engineer.

Duer, C. L., '05 .... *Box 95, Boulder, Colo.*
With Wilson and Fair, Civil and Mining Engineers.

Durell, Charles F., '95 .... *Gilt Edge, Mont.*
Manager, Central Montana Mines Co.

Dunkle, Fred W., '09 ....*Millett, (via Austin), Nev.*

Dwelle. Jesse E., '96 ....*2244 Gaylord St., Denver. Colo.*
Mining Engineer, Venture Corporation. Ltd.

Eames, L. B., '05 ....*Terry, South Dak.*

Eaton, Albert L., '95 ....*Chihuahua, Mexico*
Assistant Superintendent, Chihuahua Mining Co.

Ehle, Mark, Jr., '01 .... *Rapid City, South Dak.*
Professor of Mining, South Dakota School of Mines.

Ehrich, Walter L., '02 ....

Ellis, William W., '02 ..*300 Railway Exchange Bldg.. Denver, Colo.*
Manager, Continental Exploration Co.

Emeis. Walter A., '04 ....*Shullsburg, Wis.*
Secretary and Superintendent, Iowa Mining Co.

Emrich, Horace H., '03 ....*142 Water St., Perth Amboy, N. J.*
Assistant to Superintendent, A. S. & R. Co.

Estes, Frank M., '02 ....*El Oro, State of Mexico. Mexico*
Esperanza Mining Co.

Evans, Henry R., '00 ....*Armington, Mont.*
G. N. Railway.

Ewing. Charles R., '00 ....*Del Norte. Colo.*

Eye, Clyde M., '95 ..... *512 Schneidel Bldg., San Francisco, Cal.*
Febles, John C., '97 ..... *Box 105, Butte, Mont.*
Chemist, Anaconda Copper Co.
Field, Fred M., '95 ..... *Beatty, Nev.*
Metallurgist, Consolidated Montgomery Shoshone Mines Co.
Fillius, Lee L., '04 ..... *Telluride, Colo.*
Cyanide Department, Smuggler Union Mining Co.
Finigan, William Henry, '06 ..... *Victor, Colo.*
Assistant Engineer, Portland G. M. Co.
Fleming, William L., '03 .....
Flint, F. F., '05 ..... *R. F. D. No. 4, Greeley, Colo.*
Floyd, John A., '88 .....
Deceased.
Ford, Homer D., '05 ..... *Palmer, Mo.*
Guggenheim Exploration Co.
Foster, George C., '03 ..... *1734 Arapahoe St., Denver, Colo.*
Care Henry E. Wood & Co.
Franck, Albert C., '04 ..... *Ouray, Colo.*
Resident Engineer, Barstow M. and M. Co.
Franck, Robert P., '04 ..... *Nacozari, Sonora, Mexico*
Moctezuma Copper Co.
Frank, Harry L., '01 ..... *Dedrick, Trinity Co., Cal.*
G. M. Co.
Frank, Morton E., '06 .....
Freeland, William H., Jr., '06 ..... *Hailey, Idaho*
Fry, Louis D., '03 ..... *Silver Plume, Colo.*
Mining.
Funk, Walter A., '03 ..... *Central City, Colo.*
Mining Engineer and U. S. Deputy Mineral Surveyor.
Gardner, John Ira, '06 ..... *Silver Plume, Colo.*
Dives-Pelican Mining Co.
Garza Adalpe, J. M., '06 ..... *San Gabriel, Durango, Mexico*
Evanston Mining Co.
Gehrmann, Charles A., '86 ..... *1420 Franklin St., Denver, Colo.*
Mining Engineer.
Giddings, Donald S., '00 .. *1414 Colorado Ave., Colorado Sp'gs, Colo.*
Gilbert, Arthur K., '06 ..... *Walsenburg, Colo.*
Assistant Engineer, C. F. and I. Co.
Gilbert, William J., '06 ..... *Masonic, Cal.*
Goodale, Stephen L., '04 ..... *Lander, Cal.*
Gordon, John G., Jr., '06 ..... *Hibbing, Minn.*
Engineering Department, U. S. Steel Co., Mesabi Range.
Grant, Lester S., '99 ..... *Independence, Colo.*
Findley Con. M. Co.
Gray, Latimer D., '95 ..... *Rock Springs, Wyo.*
Manager, Electrical Department, U. P. Coal Co.
Greve, E. E., '05 ..... *492 First Ave., Brooklyn, N. Y.*
Grider, R. L., '05 ..... *Seiad Valley, Siskiyou Co., Cal.*
Mining.
Griswold, George G., '96 ..... *Salida, Colo.*
Superintendent, Ohio and Colorado Smelter.
Gross, John, '97 ..... *417 Jackson Building, Denver, Colo*
Mining and Metallurgical Engineer.

Hallett, R. L., '05 .... *Selby, Contra Costa Co., Cal.*
Chemist, A. S. and R. Co.

Hallett, W. J., '05 .... *Lake City, Colo.*
Carson Mining and Reduction Co.

Hamilton, Frank R., '98 .... *Denver, Colo.*
Denver Gas and Electric Co.

Harkison, Charles W., '06 .... *Terry, South Dak.*
Wilson Mill.

Harrington, Daniel, '00 .... *Sunnyside, Utah*
Chief Engineer, Utah Fuel Co.

Harrington, Orville. '98 ...... *1485 So. University St., Denver, Colo.*
U. S. Mint.

Harris, Willard F., '01 ....

Hartzell, Lester J., '95 .... *Butte, Mont.*
Instructor in Laboratories, Montana School of Mines.

Hawley, Howard R., '93 .... *Canon City, Colo.*
U. S. S. Co.

Hazard, William J, '97 .... *Golden, Colo.*
Assistant Professor of Electrical Engineering, Colorado School of Mines.

Heitz, George H., '06 .... *Box 526, Leadville, Colo.*
Surveyor.

Hensley, James H., '06 .... *Hadley, Ketchikan P. O., Alaska*

Hewitt, A. F., '05 .... *221 McPhee Building, Denver, Colo.*
Hewitt-Carstarphen Co., Mining and Construction Engineers.

Hill, Frank C., 'o .... *Winter Quarters, Utah*
Utah Fuel Co.

Hindry, Willis E., '92 .... *El Oro, Mexico*
General Manager, Esperanza Mining Co.

Hodgson, Arthur, '99 .... *Denver, Colo.*
Assayer, Denver Mint.

Hornbein, Julius, '05 .... *Christmas, Arizona*
Chemist, Saddle Mountain Mining Co.

Hoyt, George F., '96 .... *Golden, Colo.*

Hunt, T. R., '05 .... *Poland, Arizona*

Hyder, C. A., '05 .... *Moctezuma, Sonora, Mexico*
Mining Engineer.

Hyder, Frederick B., '03 .... *Moctezuma, Sonora, Mexico*
Mining Engineer.

Ickis, Harry M., '02 .... *Manila, P. I.*
Field Assistant, Bureau of Mines.

Ingersoll, Julius C., Jr., '06 .... *Ironton, Colo*
Chemist, Continental Smelting and Refining Co.

Ingols, J. August, '98 .... *Milford, Beaver Co., Utah*
General Superintendent, Majestic Copper M. and S. Co.

Izett, Glenn, '03 .... *Box 22, Littleton, Colo.*
Surveying and Construction Work, Denver Union Water Co.

Jackson, Walter H., '01 .... *Mapimi, Durango, Mexico*
Mining Engineer, Compania Minera de Penoles.

Jarvis, Royal P., '97 .... *Pullman, Wash.*
Professor of Mining Engineering and Metallurgy, Washington Agricultural College.

Jewel, Gilbert E., '93 .... *Queensland, Australia*
Chartres Towers.

Johnson, Edward W., '91 .... *Salt Lake, Utah*
Garfield Smelting Co.

Johnson, Gilbert, Jr., '99 ....
Deceased.

Johnson, Junius W., '01 ....
Deceased.

Johnson, Lafayette G., '04 .... *Flat River, Mo.*
Engineer, Federal Lead Co.

Johnston, Fred, '98 ....*Leadville, Colo.*
Assistant Superintendent, Arkansas Valley Plant, A. S. and R. Co.

Jones, Edward B., '00 ......*316 Dooly Block, Salt Lake City, Utah*
Consulting Mining Engineer and Metallurgist.

Jones, Fred, '00.........................*Colorado Springs, Colo.*
Mining Engineer, with J. R. Finlay.

Jones, Mrs. F. H., '98 ....*Ely, Nev.*

Jones, Frank H., '98 ....*Ely, Nev.*
Assistant Engineer, Nevada Consolidated Copper Co.

Kell, Wayne S., '06 .... *Dahlonega, Ga.*
Professor of Mining and Electrical Engineering, North Georgia Agr. College.

Kelly, Fred G., '99.........................

Kelly, William A., '97 ......*311 E. Eaton Ave., Cripple Creek, Colo.*
Cyanide Milling.

Kennedy, George A., '95 ....*719 E. and C. Building, Denver, Colo.*
Mining Engineer, Venture Company of London.

Kilbourne, William D., '04 ....*Pueblo, Colo.*
C. F. and I. Co.

Kimball, George K., Jr.. '92 ....*Idaho Springs, Colo.*
General Manager, Old Town Mining Co.

Kimball, Joseph S., '92 .... *Russell Gulch, Colo.*
Mining.

Kimball, Harlow M., '04 ....*Great Falls, Mont.*
Boston and Montana Con. Copper and Silver Mining Co.

King, Henry E., '03 ......*419 E. Kiowa St., Colorado Springs, Colo.*
Assistant City Engineer.

Kingman, Jerry, '88 ....
Deceased.

Kleff, J. Marvin, '06 ....*119 E. 8th St., Leadville, Colo.*
Yak M., M. and T. Co.

Koerner, Albert J., '06 ....*3043 Gray St., Denver, Colo.*

Kraemer, Edwin L., '98......................... *Shem City, Utah*
Utah and Eastern Copper Co.

Lampe, Oscar A., '98 ....*Guanajuato, Apartado No. 55, Mexico*
Superintendent, Cyanide Plant, G. R. and M. Co.

Larison, E. L., '05,..............................*Isabella, Tenn.*
Chemist.

Larsh, Walter S., '04 .... *Ely, Nev.*
Assistant Superintendent, Cumberland Ely Copper Co.

Lee, Robert P., '05 ....*Moctezuma, Sonora, Mexico*
Surveyor and Assayer, Sonora M. Agency.

Lee, Wallace, '04, ... *Ures, Sonora, Mexico*
Mining Engineer, care Wendler and Lee.

Lehmer, Frank W., '02 ....

Lemke, Carl, '00 . . . .
Lennox, L. W., '05 . . . . *Victor, Colo*
Strong G. M. Co.
Lerchen, F. H., '97 . . . . *Box 175, Deming, N. M*
Luna Lead Co.
Levy, Archibald L., '06 . . . . *3238 Vernon Ave., Chicago, Ill*
Superintendent, International Mining Co.
Lewis, Frank E., '01 . . . . *Orogrande, N. M*
Assayer, care S. W. and R. Co.
Lewis, William B., '92 . . . . . . *206 Coronado Building, Denver, Colo*
Lewis, Frank E., '01 . . . . *Oro Grande, N. M*
General Manager, South Canon Coal Co.
Libby, James L., '06 . . . . *Rock Springs, Wyo*
Assistant Engineer, Union Pacific Coal Co.
Liddell, Charles A., '03 . . . . *Manhattan, Nye Co., Nev*
Surveyor and Mining Engineer.
Liddell, T. Parker, '03 . . . . *Tuscarora, Nev*
Surveyor and Mining Engineer.
Limback, Edmund C., '95 . . . . *Mason P. O., Broadwater Co., Mont*
Park-New Era Mines.
Logue, N. W., '97 . . . . *El Tigre, Sonora, Mexic*
Mining Engineer.
Lonergan, P. Jay, Jr., '05 . . . . *Greenwater, Inyo County, Ca*
U. S. Deputy Mineral Surveyor.
Lorah, Bela I., '88 . . . .
Deceased.
Lovering, Ira G., '01 . . . . *1107 N. Stanton St., El Paso, Texas*
Lucy, Frank Allen, '01 . . . . *Goldfield, Nav*
Mining Engineer.
Lucy, Richarw W., '98 . . . . *Central City, Colo*
McCart, Robert, '95 . . . . *Silverton, Colo*
Engineer, Silver Lake Mines.
McDaniel, A. K., '95 . . . . *111 W. 4th Ave., Denver, Col*
Mining Engineer.
McDermutt, Grace C. U., '03 . . . . *Washington, D. C*
Bureau of Standards.
McElvenny, Robert F., '03 . . . . . . *1420 N. Steele St., Tacoma, Wash*
Superintendent, Lead Works, American Smelters Supply Co.
MacGregor, George H., '97 . . . . *Central City, Colo*
Mine Superintendent, New Foundland Mine.
McLeod, J. Norman, '97 . . . . *1734 Glenarm St., Denver, Colo*
Assayer and Chemist.
McMahon, Charles H., '92. . *Asientos, State of Aguas Calientes, Mex*
Mine Superintendent, A. S. and R. Co.
Magenau, William '98 . . . . *Box 232, Deming, N. M*
Smelter Superintendent.
Malmstrom, C. Clarence, '00 . . . . . . *1109 E. 13th Ave., Denver, Colo*
Assayer, Denver Mint.
Marrs, George O., '01 . . . . *Denver, Colo*
Montgomery Machinery Co.
May, John G., '01 . . . . *Oxford Hotel, Denver, Colo*
Mining Engineer.

Maxwell, Fred A. G., '95 *Box 2, Randfontein, Transvaal, S. Africa*
Metallurgist, Randfontein Estates.
Maynard, Rea E., '96 ....
Merryman, Herbert E., '95 ....*Enterprise, Ore.*
U. S. Deputy Mineral Surveyor.
Merwin, Eugene W., '03 ..*Room 17, Court House, Los Angeles, Cal.*
Middelkamp, L. L., '05 ....*106 14th Ave. N., Seattle, Wash.*
Middleton, William B., '83 ....
Millard, Frank W., '01 ....*Ely, Nev.*
Mining Engineer.
Milliken, John F., '96 ....*Colorado Springs, Colo.*
Superintendent, Golden Cycle Mining Co.
Milliken, William B., '93 ....*8th and Larimer Sts., Denver, Colo.*
F. M. Davis Iron Works Co.
Mitchell, George B., '96 ....*New Haven, Conn.*
Superintendent of Buildings, N. Y., N. H. and H. R. R.
Montrose, James F., '02 ....*1549 St. Paul St., Denver, Colo.*
Moss, Cleveland O., '02 ....*El Tiro, via Red Rock, Arizona*
Superintendent, Cleveland Arizona Mining Co.
Moynahan, Ambrose E., '00 ....*Alma, Colo.*
Assayer and Mining Engineer.
Muir, David, '99 .... *Yaalpom, Cal.*
Muir, Douglas, '05 .... *Guanajuato, Gto. Mexico*
Mining Engineer.
Nagel, Frank J., '03 ....*2335 Stout St., Denver, Colo.*
Nagel, Henry P., Jr., '04 ....*2335 Stout St., Denver, Colo.*
Nance, William H., '96 ....*Breckenridge, Colo.*
Superintendent of Milling Department, Quandary Mt. M. and M. Co.
Nelson, H. E., '97 .... *Colorado Springs, Colo.*
Colden Cycle Mining Co.
Neugebauer, Karl E., '06 ....*Mapimi, Durango, Mexico*
Compania Minera de Penoles.
Neville, J. B., Jr., '05 ....*836 Ogden St., Denver, Colo.*
Newman, William E., '96 .... *Omaha, Neb.*
Chemist, Omaha Plant, American Smelting and Refining Co.
Nicolson, George W., '00 .... *Box 34, Mojave, Cal.*
Norman, John E., '98 ..*302 Mining Exchange Bldg., Denver, Colo.*
Mining Engineer.
Nyberg, H. Edward, '06 ....*Deadwood, S. Dak.*
Nye, Robert, '97 .... *Placerville, Idaho*
Moline Mining Co.
O'Byrne, Joseph F., '05 ....*Barlow Mine, Lumpkin Co., Ga.*
Manager, Barlow Mine, Dahlonega Con. Gold Mining Co.
Osborne, Arthur H., '93...................... *Georgetown, Colo.*
Mining Engineer and U. S. Mineral Surveyor.
Palsgrove, Harry G., '03 ....*Coahuila, Mexico*
Paredes, Evaristo, Jr., '05 ....*Culiacan, Sinaloa, Mexico*
Assistant Engineer, Sinaloa Land and Water Co.
Parks, George A., '06 ....*3081 W. 26th Ave., Denver, Colo.*
Parker, James H., '95..*Rooms 13-14, Masonic Temple, El Paso, Tex.*
Mining Engineer.

Parrish, Carl C., '01 .... *Colombia, South America*
Mining Engineer.
Parsons, Horace F., '03 .... *Salt Lake City, Utah*
Patterson, S. B., Jr., '06.......................... *Robesonia, Pa.*
Robesonia Iron Co.
Paul, Russell B., '02 .... *San Juancito, Honduras, Central America*
Mining Engineer, New York and Honduras Rosario M. Co.
Paul, William H., '96 ....*206 Equitable Bldg., Denver, Colo.*
Mining Engineer, Empire Zinc Co.
Pendery, John M., '00 .... *Leadville, Colo.*
Yak Tunnel M. and M. Co.
Pfeiffer, G. N., '05 .... *925 5th Ave., Durango, Colo.*
Surveyor.
Pilger, Newton W., '06 .... *Ruby, Mont.*
Assistant Engineer, Conrey Placer Mining Co.
Platt, Edwin H., '00 .... *Coahuila, Mexico*
Jimulco Mining Co.
Post, George M., '94 .... *2928 Hale St., Denver, Colo.*
Assistant City Engineer.
Powell, George F., '97 .... *Idaho Springs, Colo.*
Superintendent, Stanley Mine.
Powers, Oliver, '02 .... *Oakland, Cal.*
Pray, Winfred A., '01 .... *Wadsworth, Nev.*
Surveyor.
Pressler, L. P., '05 .... *Vantrent, Cal.*
Assayer, Dairy Farm Mining Co.
Price, Lyttleton, Jr., '00 .... *Bellvue, Idaho*
Minnie Moore Mining Co., Ltd.
Prier, Truman Delmar, '04 .... *Ruby, Mont.*
Engineer, Conrey Placer Mining Co.
Prout, John, '00 .... *Golden, Colo.*
Putnam, George B., '05 .... *137 W. 9th St., Leadville, Colo.*
Mining Engineer and Surveyor.
Rabb, E. M., '05 ......*Box 4, Pilares de Nacozari, Sonora, Mexico*
Moctezuma Copper Co.
Rath, C. M., '05 .... *Hanna, Wyo.*
Assistant Engineer, U. P. Coal Co.
Reinhard, F. J., '05 .... *Shoshoni, Wyo.*
Reno, Horace T., '02 .... *Arvada, Colo.*
Rhodes, William B., '03 .... *Rosario, Sinaloa, Mexico*
Mines del Tojo, via Tepic.
Richards, E. R., '05 .... *St. Elmo, Colo.*
Assayer.
Richards, John V., '02 .... *Stillwater, Nev.*
Ripley, G. Clinton, '06 .... *Box 5, Tonopah, Nev.*
Hannapah M. and S. Co.
Rising, Arthur F., '99 ....
Deceased.
Robey, Loyd, '00 .... *San Gabriel, Durango, Mexico*
Mining Engineer, San Louis Mining Co.
Robinson, George P., '04 .... *Howardsville, Colo*
Highland Mary Mine, Gold Tunnel Drainage and T. Co.

Rodriguey, J. C., '98 .... *City of Mexico, Mexico*
Mining Engineer.
Roller, Arthur H., '97 .... *Idaho Springs, Colo.*
Manager, Shafter Mine Co. and Hudson Reduction Co.
Rowe, Charles E., '02 .... *Austin, Texas*
Professor of Mining Engineering, University of Texas.
Rowe, Edward E., '95............. *1250 Boulevard F, Denver, Colo.*
Manager E. E. Rowe & Co., Pressed Brick.
Royer, Frank W., '99 .... *4003 W. 35th Ave., Denver, Colo.*
Mining Engineer.
Rudd, Arthur H., '00 .... *Enterprise, Ore.*
Mining Engineer.
Ryan. W. E., '05 .... *Room 5, Union Depot, Pueblo, Colo.*
D. and R. G. R. R.
Saint Dizier, Julius D., '94 .... *San Luis Potosi, Mexico*
Sale, Andrew J., '00 .... *Box 386, Cripple Creek, Colo.*
Scheble, Max C., '01 .... *Sabinas, Coahuila, Mexico*
Superintendent, Gral Compania Carbomfus.
Schlereth, C. Quimby, '06 .... *Ojuela, Durango, Mexico*
Compania Minera de Penoles.
Schneider, George W., '94 .... *136 Logan Ave., Denver, Colo.*
State Mine Inspector.
Schumann, Enrique A., '97 ....
Sherman, Scott H., '04 .... *Jardine, Mont.*
Kimberly-Montana G. M. Co.
Shetler, Waverly, '95 ....
Deceased.
Sill, Rush T., '06 .... *Hibbing, Minn.*
Geological and Mining Department, Great Northern R. R.
Simpson, William P., '01 ....
.... *Apartado 101, Monterrey, Nuevo Leon, Mexico*
Head Assayer, Monterrey Plant, A. S. and R. Co.
Skinner, Lewis B., '95 .... *Denver, Colo.*
Consulting Chemist and Metallurgist, Western Chem. Manufacturing Co.
Sloan, Arthur W., '03 .... *Silver City, N. M.*
Chemist, Silver City Reduction Works.
Slater, Amos E., '00 .... *Tacoma, Wash.*
Geologist, Northern Pacific Railway.
Small, Harvey B., '01 .... *Colombia, South America*
Mining Engineer.
Smith, C. Dupre, '91 .... *Newton, Iowa*
Consulting Mining and Metallurgical Engineer.
Smith, Claude H., '00 ....
Deceased.
Smith, E. M., '05 .... *Box 246, Montrose, Colo.*
Smith, Harry C., '98 .... *1132 Washington Ave., Denver, Colo.*
Mining Engineer.
Smith, Thomas G., '99 .... *233 So. Emerson St., Denver, Colo.*
Spangler, Howard, '05 .... *Victor, Colo.*
Assistant Engineer, Portland G. M. Co.
Spencer, Walter I., '04 .... *868 E. Ash St., Portland, Ore.*
Civil and Contracting Engineer.

Stannard, Burt C., '95 .... *Everett, Wash*
Chemist, Puget Sound Reduction Co.
Starbird, H. B., '97 ....*2646 Magnolia Ave., Los Angeles, Cal.*
Mining Engineer.
Starbird, Edwin P., '01 ......*2646 Magnolia Ave., Los Angeles, Cal.*
Mining Engineer.
Steele, James H., '00 ....*1041 Lafayette St., Denver, Colo*
Instructor in Mathematics and Drafting, M. T. H. S.
Steinhauer, F. C., '99 .... *Denver, Colo.*
Assistant Engineer, Board of Public Works.
Stephens, Charles N., '98 ....*Box 234, Oshkosh, Wis.*
Surveyor, Survey of Lake Winnebago.
Stephens, Wallace A., '93 ....*1361 Logan Ave., Denver, Colo.*
Mining.
Stephenson, Tiffany E., '06 ....*115 W. Quartz St., Butte, Mont*
Gagnon Mine.
Stockton, Robert S., '95 ....*Huntley, Mont.*
U. S. Reclamation Service.
Stoeckley, E. F., '06 ....*Greenwater, Inyo Co., Cal.*
U. S. Deputy Mineral Surveyor.
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Strout, Fred M., '96 ....*Deadwood, So. Dak.*
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Suhr, Otto B., '95 ....*Provo, Utah*
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Testing Department, A. C. M. Co.

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Assayer, Salvador Mines, Ltd.

Wertheim-Salomonson, F. M. G. A., '89 ......
Deceased.

Wheeler, Charles E., 94 ....

Whitaker, Orville R., '98 .... *Mapimi, Durango, Mexico*
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Wiley, Walter H., '83. .*367 So. Bonnie Brae St., Los Angeles, Cal.*
Mining Engineer.

Williams, Fred T., '01 .... *Victor, Colo.*
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Superintendent, Granby Smelter.

Wolf, Harry J., '03 .... *Ouray, Colo.*
Chief Engineer, Camp Bird Mine.

Woods, Thomas H., '97 .... *Box F, Ouray, Colo*
Superintendent, Camp Bird Mill, Ltd.
Young, Frank B., '95 .... *Lindsay, Cal*
Mining Engineer.

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Blow, A. A. .... *London, England*
Mining Engineer.
Hale, Gen. Irving .... *Denver, Colo.*
General Agent, Gen. Electric Co.
Bulkley, Frank .... *Denver, Colo.*
Mining Engineer.
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Governor of Colorado.

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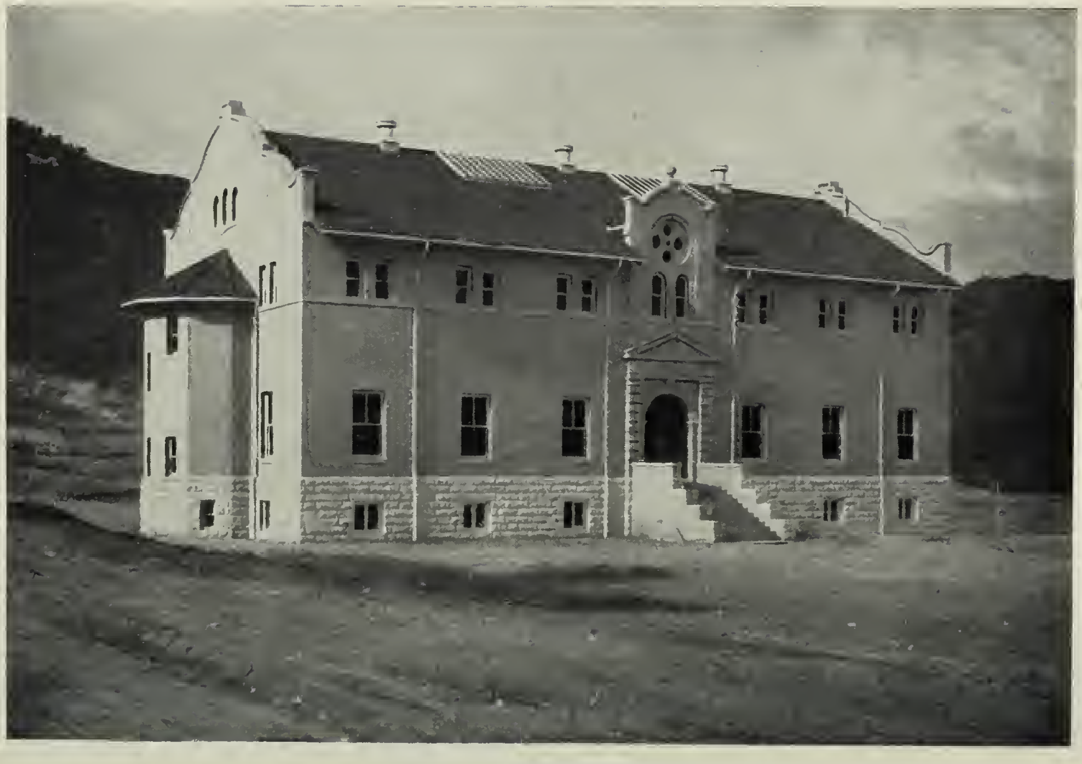

NEW GYMNASIUM, 1908
COLORADO SCHOOL OF MINES
GOLDEN, COLORADO

QUARTERLY

OF THE

COLORADO SCHOOL OF MINES

Vol. III. No. 2.

Catalogue Edition

GOLDEN, COLORADO
1908-1910

A. D. W.

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COLLEGE CALENDAR.

1908.

November	26, Thursday	Thanksgiving Recess.
November	27, Friday	
December	21, Monday	Christmas Recess Begins.

1909.

January	2, Saturday	Christmas Recess Ends.
January	23, Saturday	First Semester Ends.
January	25, Monday	Second Semester Begins.
February	12, Friday	Lincoln's Birthday. (A Holiday.)
February	22, Monday	Washington's Birthday. (A Holiday.)
May	28, Friday	Second Semester Ends. Commencement Exercises.
May	31, Monday	Field Surveying Begins.
June	26, Saturday	Field Surveying Ends.
September	1, Wednesday	Examination for entrance to the class of 1913, and re-examination of matriculated students.
September	2, Thursday	
September	3, Friday	
September	7, Tuesday	Opening of the first Semester of the Academic year 1909-10.
November	25, Thursday	Thanksgiving Recess.
November	26, Friday	
December	20, Monday	Christmas Recess Begins.

1910.

January	1, Saturday	Christmas Recess Ends.
January	22, Saturday	First Semester Ends.
January	24, Monday	Second Semester Begins.
February	12, Saturday	Lincoln's Birthday. (A Holiday.)
February	22, Tuesday	Washington's Birthday. (A Holiday.)
May	27, Friday	Second Semester Ends. Commencement Exercises.
May	30, Monday	Field Surveying Begins.
June	25, Saturday	Field Surveying Ends.
August	31, Wednesday	Examinations for entrance to the Class of 1914, and re-examination of matriculated students.
September	1, Thursday	
September	2, Friday	
September	6, Tuesday	Opening of the first Semester of the Academic year 1910-1911.

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HISTORY, ORGANIZATION, FINANCIAL SUPPORT, AND LOCATION.

HISTORY.

The Colorado School of Mines was established by an act of the Territorial Legislature, approved February 9, 1874. After an unsatisfactory experience in temporary quarters, the school was permanently housed in the original "building of 1880," upon land given by the citizens of Golden. Since then the School has enjoyed a strong and steady growth in buildings, in equipment, in students, in Faculty, and in the strength and rigor of its courses. Additions were made to the original building of 1880, by the buildings of 1882, and by the building of 1890, now united and called the Hall of Chemistry. The Hall of Physics was erected in 1894, the Assay Laboratory in 1900, and Stratton Hall in 1904. The Heating, Lighting, and Power Plant was completed in 1906. The new Administrative Building, named Simon Guggenheim Hall, for the donor, was also erected in 1906. The Gymnasium was completed in 1908.

ORGANIZATION.

The corporate name of the institution by statute is "The School of Mines." The general management of the Colorado School of Mines is vested by statute in a Board of Trustees, consisting of five members appointed by the Governor of the State, with the advice and consent of the Senate. The members of the Board of Trustees are appointed in alternating sets of two and three, and hold their office for a period of four years and until their successors are appointed and qualified. The Board of Trustees elect one of their number President. They also appoint a Secretary and a Treasurer either from their own number, or from some other suitable persons, as they may deem best. Any three of said Board of Trustees constitute a quorum for the transaction of business. The President of the Faculty of the School, who shall be appointed by the said Board of Trustees, shall be known as "President of the School of Mines." By the organic Constitution of Colorado, the School of Mines is regarded as an Institution of the State.

FINANCIAL SUPPORT.

The Colorado School of Mines is supported by the income derived from the annual tax of one-fifth of a mill on each dollar of the assessed property of the State, and this is known as the "School of

Mines Tax." In addition to this the Legislature has from time to time provided by special appropriation for such emergency funds as the means of the State treasury and the necessities of the School might suggest.

LOCATION.

The Colorado School of Mines is in the south central part of the city of Golden, Jefferson County. Golden is about thirteen miles from Denver, and can be reached by the Colorado & Southern Railroad from the Union Station, at the foot of Seventeenth Street; by the Denver and Intermountain Railway, from the Arapahoe Street Station, between Fourteenth and Fifteenth Streets; or by the Denver & Northwestern Electric Railway, from the Loop on Fifteenth Street, between Arapahoe and Lawrence Streets, Denver.

Golden has about three thousand inhabitants, and is one of the oldest cities in Colorado. It is such a residence town as usually clusters around a college, and is the most available mountain or foothill home suburban to and available from Denver. The altitude is five thousand seven hundred feet above sea level, or about four hundred fifty feet higher than Denver. The climate is invigorating and pleasant, with open winters and a large proportion of clear days. The surrounding region is rich in the characteristic scenery of the Rocky Mountain region.

The Colorado School of Mines is peculiarly well located to give students both a theoretical and a practical training. The equipment of the school enables the theoretical side to be well presented. The nearness to mines, mills, and smelters offers unusual opportunities for inspection visits, and enables the student to see in actual operation every variety of mining and metallurgical work. The Independent Pyritic Smelter is located at Golden. In the Clear Creek canon are the numerous gold mills and concentrators of Gilpin and Clear Creek counties. At Argo, near Denver, the Boston & Colorado Smelting Company illustrates the metallurgy of gold, silver, and copper ores At the Globe plant of the American Smelting & Refining Company the treatment of lead ores and dry ores of gold and silver is illustrated by modern methods. At Denver also are the Colorado Zinc Works, using the most modern methods of magnetic and electric separation, and in addition there are numerous sampling and ore testing works. The many mining and metallurgical machinery plants of Denver also afford an excellent opportunity for becoming acquainted with recent improvements in metallurgical design. At Colorado City are the Portland and Standard mills for the chlorination treatment of gold ores, and the Golden Cycle Mill for cyanidation; at Cripple Creek, the Cripple Creek and Homestake mills; and at Florence, the Union Mill. The plant of the Colorado Fuel & Iron Company at Pueblo possesses all the recently invented and approved devices for the production of iron and steel and for working these products into marketable forms. At Pueblo there are also three lead smelters, the Pueblo, Eilers and Philadelphia, and the zinc smelter of the Colorado Zinc Company. At Canon City are the plants of the Empire Zinc Company and of the United States Reduction and Refining Company, and at Leadville, the Arkansas Valley smelter. The Black Hills, where good practice in gold milling and cyanidation is to be found, and the great copper smelters of Montana, are easily reached.

At or near Golden are numerous clay mines and quarries and extensive coal mines well equipped with hoisting and power machinery. In the Clear Creek canon, within a short ride of Golden, are the mining camps of Central City, Black Hawk, Idaho Springs, and Georgetown, and placer mining at Breckenridge. The well-known mining camps of Cripple Creek, Victor, Leadville and Aspen, as well as the San Juan region, including Silverton, Ouray, and Telluride, are also easily reached by train from Denver. Besides these there are also available the bituminous mines of the Northern Coal Fields, the anthracite fields of Glenwood Springs, the oil fields of Florence, the iron mines of Wyoming, and the copper regions of Arizona and Montana.

No other mining school in the country has within easy access such a wide variety of mining properties, or such excellent opportunities for observing the latest and best milling and smelting operations.

REQUIREMENTS FOR ADMISSION.

FRESHMAN CLASS.

Unit Course. A unit course of study is defined as a course covering a school year of not less than thirty-six weeks, with five periods of at least forty-five minutes each per week.

Fifteen Units are required for entrance, of which twelve are specified, and three may be chosen from a list of electives.

SPECIFIED UNITS.

Essentials of Algebra	1	unit
Advanced Algebra	½	unit
Plane Geometry	1	unit
Solid Geometry	½	unit
Languages, other than English	2	units
English	3	units
History	2	units
Physics	1	unit
Chemistry	1	unit
Specified Units	12	
Elective Units	3	
Total Units for Entrance	15	

ELECTIVE UNITS.

The three elective units may be selected from the following list: Drawing, Shop Work, Mathematics, Greek, French, German, Spanish, History, English, Science, Psychology, Political Economy.

In allowing credit for drawing and shop work two forty-five minute periods will be regarded as equivalent to one forty-five minute period of classroom work. Half units are accepted in all studies, except in physics and chemistry, provided that not less than one full unit shall be accepted in language.

METHODS OF ENTRANCE.

(a) By Certificate.

Graduates of Accredited High Schools in the State of Colorado will be admitted without examination upon the presentation of proper credentials from the Principal of their High School, provided that the studies they have successfully completed cover the requirements for admission. Blanks for this purpose will be sent on application to the President.

Graduates of Accredited High Schools in other States will be accepted in the same manner as graduates of Accredited High Schools in Colorado.

(b) By Examination.

All other candidates for admission will be required to pass entrance examinations in the specified subjects. These examinations are held in Golden.

For the benefit of students who cannot, on account of the distance, conveniently take the examination at Golden, arrangements will be made so that they may take the examinations under the direction of some responsible person at or near their own homes.

Entrance examinations for the class of 1913 will be held in Golden on Wednesday, Thursday and Friday, September 1, 2 and 3, 1909.

Entrance examinations for the class of 1914 will be held in Golden on Wednesday, Thursday and Friday, August 31, September 1 and 2, 1910.

It is the opinion of the Faculty of the Colorado School of Mines that every candidate for the Freshman class should have taken a thorough course of at least four years in a good High School or in a Manual Training School, and during the last year of his preparation, should have a thorough review of mathematics, or should have received an education equivalent to one of these. The work of the school is so exacting that students who are not well prepared cannot expect to succeed after entrance.

DESCRIPTION OF THE UNITS REQUIRED FOR ENTRANCE.

ENGLISH (3 UNITS).

(a) GRAMMAR. The student should have a sufficient knowledge of English grammar to enable him to point out the syntactical structure of any sentence which he encounters in the prescribed reading. He should also be able to state intelligently the leading grammatical principles when he is called upon to do so.

(b) READING. The books prescribed by the Joint Committee on Uniform Entrance Requirements in English form the basis for this part of the work.

The list is divided into two parts, the first consisting of books to be read with attention to their contents rather than to their form, the second consisting of books to be studied thoroughly and minutely. The lists, thus divided, are as follows for 1909, 1910, and 1911.

I. Books prescribed for reading.

Group I. (Two to be selected).

Shakespeare's *As You Like It, Henry V, Julius Caesar, The Merchant of Venice, Twelfth Night.*

Group II. (One to be selected).

Bacon's *Essays;* Bunyan's *The Pilgrim's Progress, Part I; The Sir Roger de Coverley Papers* in *The Spectator;* Franklin's *Autobiography.*

Group III. (One to be selected).

Chaucer's *Prologue;* Spencer's *Faerie Queene* (selections); Pope's *The Rape of the Lock;* Goldsmith's *The Deserted Village;* Palgrave's *Golden Treasury (First Series), Books II and III,* with especial attention to Dryden, Collins, Gray, Cowper and Burns.

Group IV. (Two to be selected).

Goldsmith's *The Vicar of Wakefield;* Scott's *Ivanhoe;* Scott's *Quentin Durward;* Hawthorne's *The House of the Seven Gables;* Thackeray's *Henry Esmond;* Mrs. Gaskell's *Cranford;* Dickens' *A Tale of Two Cities;* George Eliot's *Silas Marner;* Blackmore's *Lorna Doone.*

Group V. (Two to be selected).

Irving's *Sketch Book;* Lamb's *Essays of Elia;* De Quincey's *Joan of Arc* and *The English Mail Coach;* Carlyle's *Heroes and Hero Worship;* Emerson's *Essays;* Ruskin's *Sesame and Lilies.*

Group VI. (Two to be selected).

Coleridge's *The Ancient Mariner;* Scott's *The Lady of the Lake;* Byron's *Mazeppa* and *The Prisoner of Chillon;* Palgrave's *Golden Treasury (First Series), Book IV,* with especial attention to Wordsworth, Keats and Shelley; Macaulay's *Lays of Ancient Rome;* Poe's *Poems;* Lowell's *The Vision of Sir Launfal;* Arnold's *Sohrab and Rustum;* Longfellow's *The Courtship of Miles Standish;* Tennyson's *Gareth and Lynette, Lancelot and Elaine,* and *The Passing of Arthur;* Browning's *Cavalier Tunes, The Lost Leader, How They Brought the Good News from Ghent to Aix, Evelyn Hope, Home Thoughts from Abroad, Home Thoughts from the Sea, Incident of the French Camp, The Boy and the Angel, One Word More, Hervé Riel, Pheidippides.*

II. Books prescribed for study and practice.

Shakespeare's *Macbeth;* Milton's *Lycidas, Comus, L'Allegro,* and *Il Penseroso;* Burke's *Speech on Conciliation with America* or Washington's *Farewell Address* and Webster's *First Bunker Hill Oration;* Macaulay's *Life of Johnson,* or Carlyle's *Essay on Burns.*

(c) COMPOSITION. Regular and persistent training in both written and oral composition should be given throughout the entire school course. The topics should be so chosen as to give practice in the four leading types of prose discourse, namely, description, narration, exposition, and argument.

(d) Rhetoric. It is expected that the student will be familiar with the essential principles of rhetoric. The instruction in this subject should include the following particulars: choice of words, structure of sentences and paragraphs, the principles of narration, description, exposition and argument. The teacher should distinguish between those parts of rhetorical theory which are retained in text books merely through the influence of tradition and those which have direct bearing upon the composition work. The former may be safely omitted.

HISTORY (2 Units).

Any two of the following may be offered.

I. Ancient History, with special reference to Greek and Roman History, including also a short introductory study of the more ancient nations and the chief events of the early middle ages, down to the death of Charlemagne (814).

II. Mediaeval and Modern European History, from the death of Charlemagne to the present time.

III. English History.

IV. American History, or American History and Civil Government.

PHYSICS (I Unit).

Physics. The equivalent of Carhart and Chute's *High School Physics*, or Gage's *Principles of Physics*, including systematic laboratory practice such, for example, as is outlined in Crew and Tatnall's *Laboratory Manual in Physics.*

CHEMISTRY (1 Unit).

General Chemistry. The equivalent of Bradbury's *Elementary Chemistry* or Remsen's *Briefer Course of Inorganic Chemistry, with experiments.*

MATHEMATICS (3 Units).

I. Essentials of Algebra. (1 Unit.) The four fundamental operations for rational algebraic expressions; factoring; complex fractions; the solution of equations of the first degree containing one or more unknown quantities; radicals; theory of indices; quadratic equations and equations containing one or more unknown quantities that can be solved by the methods of quadratic equations; problems dependent on such equations.

II. Advanced Algebra. (½ Unit.) This course should begin with a thorough review of the essentials. Later work should cover an introduction to the graphical representation of linear and simple quadratic expressions; ratio and proportion; variation; binomial theorem; the progressions; an elementary treatment of series; partial fractions; complex numbers and logarithms.

III. Plane Geometry. (1 Unit.) Completed, including the solution of original exercises and numerical problems.

IV. Solid Geometry. (½ Unit.) Properties of straight lines and planes; of dihedral and polyhedral angles; of projection; of polyhedrons, including prisms; of pyramids and the regular solids; of cylinders, cones and spheres; of spherical triangles, and the measurement of surfaces and solids.

The two units required in languages other than English may be offered in Greek, Latin, French, German, or Spanish.

ADMISSION TO ADVANCED STANDING.

Postgraduate Students. Applicants who are graduates of colleges or technical schools of good standing will be admitted upon the presentation of proper credentials and will be permitted to take any subject taught in connection with the regular courses. Each case will be judged on its own merits, but such applicants will be advised to become candidates for a degree and to complete one of the regular postgraduate courses of the college. Such graduates will find the advanced work of the school well adapted to fit them for professional engineering work.

Undergraduate Students. Applicants who have partially completed the course in colleges or technical schools of good standing will be admitted upon the presentation of proper credentials. Due credit will be allowed for the successful completion of work which is equivalent to that given in the Colorado School of Mines. Plates of drawings, laboratory note books, and catalogues of the institution attended, should be submitted with applications for advanced standing. *The college does not admit special students.* All applicants for advanced standing are expected to enroll in one of the regular classes and to become candidates for a degree. Application blanks for advanced standing will be furnished on request to the President.

DEPARTMENTS OF INSTRUCTION.

TABULAR VIEW.

MINING ENGINEERING.

Freshman Year.

FIRST SEMESTER.	Lect. Hr.	Lab. Hr.	SECOND SEMESTER.	Lect. Hr.	Lab. Hr.
College Algebra [p. 78]....	5		Analytic Geometry [p. 79].	5	
Trigonometry [p. 79]......	3		Elements of Analysis [p. 79]	3	
General Chemistry [p. 70].	5		General Chemistry [p. 70]..	5	
Qualitative Analysis			Qualitative Analysis		
Lectures [p. 71]........	1		Lectures [p. 71]........	1	
Laboratory [p. 72]......		9	Laboratory [p. 71]......		6
Descriptive Geometry					
Lectures [p. 61]........	2		Elementary Machine Design [p. 61]............	2	
Drawing [p. 61]........		6	Engineering Drawing [p. 61]		9
General Geology [p. 52]....	3		Plane Surveying [p. 56]...	2	

Plane Surveying: Field-Work [p. 56]. Four weeks in the summer following the regular college year.

The courses are described on the pages indicated after each course.

TABULAR VIEW.

MINING ENGINEERING—Continued.

Sophomore Year.

FIRST SEMESTER	Lect. Hr.	Lab. Hr.	SECOND SEMESTER.	Lect. Hr.	Lab. Hr.
Differential and Integral Calculus [p. 79]	5		Integral Calculus [p. 80] Mechanics [p. 80]	3 2	
General Physics: mechanics, light and sound [p. 76]	4		General Physics: electricity, magnetism and heat [p. 76]	4	
Physical Laboratory [p. 77]		3	Physical Laboratory [p. 77]		3
Quantitative Analysis: Gravimetric.			Quantitative Analysis: Volumetric.		
Lectures [p. 72]	1		Lectures [p. 72]	1	
Laboratory [p. 72]		9	Laboratory [p. 72]		9
Industrial Chemistry [p. 73]	2		Industrial Chemistry [p. 73]	2	
Crystallography			Mineralogy		
Lectures [p. 54]	2		Lectures [p. 54]	2	
Laboratory [p. 54]		6	Laboratory [p. 54]		6
Mine Surveying [p. 38]	2		Mine Surveying [p. 38]	2	

Geological Field-Work [p. 52].

Mine Surveying: Field-Work [p. 59]. Four weeks in summer following the regular college year.

Mining trips to Central City, Idaho Springs, and the Northern Colorado Coal Field. [p. 83].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

MINING ENGINEERING—Continued.

Junior Year.

First Semester	Lect. Hr.	Lab. Hr.	Second Semester	Lect. Hr.	Lab. Hr.
Advanced Geology [p. 53]	4		Lithology		
			Lectures [p. 55]	2	
			Laboratory [p. 55]		3
Metallurgy: general metallurgy, iron, and steel [p. 46]	3		Metallurgy: lead and zinc [p. 46]	3	
Mining [p. 39]	3		Mining [p. 39]	3	
Mechanics of Engineering [p. 57]	3		Mechanics of Engineering [p. 58]	3	
Engineering Construction			Mill Construction		
Lectures [p. 58]	2		Lectures [p. 58]	2	
Drawing [p. 58]		3	Drawing [p. 58]		3
Machine Design			Steam Engines and Boilers		
Lectures [p. 62]	2		Lectures [p. 62]	2	
Drawing [p. 62]		6	Drawing [p. 62]		6
Electric Power Transmission			Electric Power Transmission		
Lectures [p. 68]	2		Lectures [p. 68]	2	
			Laboratory [p. 68]		3
Assaying			Structural Materials Testing Laboratory [p. 57]		3
Lectures [p. 46]	1				
Laboratory [p. 46]		6			
Metallurgical Trips [p. 83]			Metallurgical Trips [p. 83]		
1. Iron and Steel Works			1. Lead Smelter		
2. Sampling Plant			2. Zinc Smelter		
3. Smelting plant for the study of furnace types					

Mining Trip to Cripple Creek [p. 83].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

MINING ENGINEERING—Concluded.

Senior Year.

FIRST SEMESTER	Lect. Hr.	Lab. Hr.	SECOND SEMESTER	Lect. Hr.	Lab. Hr.
Economic Geology [p. 53]	3		Economic Geology [p. 53]	3	
Ore Dressing			Metallurgy: gold, silver, and copper		
Lectures [p. 47]	3		Lectures [p. 49]	2	
Laboratory [p. 47]		3	Laboratory and Practice [p. 49]		3
Hydraulics [p. 59]	2		Contracts and Specifications [p. 60]	2	
Hydraulic and Cement Laboratory [p. 59]		3			
Compressed Air Machinery [p. 63]	2		Pumping Machinery [p. 64]	2	
Gas Engines [p. 64]	2				
Mechanical Engineering Laboratory [p. 64]		3	Mining Laboratory [p. 42]		3
Power Plant Design			Mine Plant Design		
Lectures [p. 63]	2		Lectures [p. 63]	2	
Drawing [p. 63]		6	Drawing [p. 63]		6
Mining [p. 40]	2		Mining [p. 40]	2	
Mine Examination and Reports [p. 41]	1		Economics of Mining [p. 41]	2	
Thesis		3	Thesis		6
English [p. 82]	1		English [p. 82]	1	
Ore Dressing Trips [p. 83]			Metallurgical Trips [p. 83]		
1. Sampling Works			1. Copper Smelter		
2. Concentrating Plants			2. Gold Milling Plant		
3. Magnetic and Electric Separating Plants			3. Cyanide and Chlorination Mills		

Geology. Advanced Field-Work [p. 53].

Senior Mining, Metallurgical, Engineering, and Geological Trip [p. 85].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING.

Freshman Year.

FIRST SEMESTER	Lect. Hr.	Lab. Hr.	SECOND SEMESTER	Lect. Hr.	Lab. Hr.
College Algebra [p. 78]....	5		Analytic Geometry [p. 79].	5	
Trigonometry [p. 79]......	3		Elements of Analysis [p. 79].................	3	
General Chemistry [p. 70].	5		General Chemistry [p. 70]..	5	
Qualitative Analysis			Qualitative Analysis		
Lectures [p. 71]........	1		Lectures [p. 71].......	1	
Laboratory [p. 71]......		9	Laboratory [p. 71]......		6
Descriptive Geometry					
Lectures [p. 61]........	2		Elementary Machine Design [p. 61]............	2	
Drawing [p. 61]........		6	Engineering Drawing [p. 61].................		9
General Geology [p. 52]...	3		Plane Surveying [p. 56]....	2	

Plane Surveying: Field-Work [p. 56]. Four weeks in the summer following the regular college year.

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING—Continued

Sophomore Year.

First Semester	Lect. Hr.	Lab. Hr.	Second Semester	Lect. Hr.	Lab. Hr.
Differential and Integral Calculus [p. 79]........	5		Integral Calculus [p. 80]..	3	
			Mechanics [p. 80].........	2	
General Physics: mechanics, light and sound [p. 76]..	4		General Physics: electricity, magnetism, and heat [p. 76]................	4	
Physical Laboratory [p. 77]................		3	Physical Laboratory [p. 77]................		3
Quantitative Analysis: Gravimetric.			Quantitative Analysis: Volumetric.		
Lectures [p. 72].........	1		Lectures [p. 72].......	1	
Laboratory [p. 72]......		9	Laboratory [p. 72]......		9
Industrial Chemistry [p. 73]................	2		Industrial Chemistry [p. 73]................	2	
Crystallography			Mineralogy		
Lectures [p. 54].........	2		Lectures [p. 54].........	2	
Laboratory [p. 54]......		6	Laboratory [p. 54]......		6
Mine Surveying [p. 38]....	2		Mine Surveying [p. 38]....	2	

Geological Field-Work [p. 52].

Mine Surveying: Field-Work [p. 39]. Four weeks in summer following the regular college year.

Mining trips to Idaho Springs, Central City, and the Northern Colorado Coal Field [p. 83].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING—Continued.

Junior Year.

FIRST SEMESTER	Lect. Hr.	Lab. Hr.	SECOND SEMESTER	Lect. Hr.	Lab. Hr.
Advanced Geology [p. 53]..	4		Lithology		
			Lectures [p. 55]........	2	
			Laboratory [p. 55]......		3
Metallurgy: general metallurgy, iron, and steel [p. 44]................	5		Metallurgy: lead, zinc, antimony, bismuth, and cadmium [p. 45]........	5	
Mining [p. 39]...........	3		Mining [p. 39]..........	3	
Mechanics of Engineering [p. 57]................	3		Mechanics of Engineering [p. 58]................	3	
Engineering Construction			Mill Construction		
Lectures [p. 58].........	2		Lectures [p. 58].........	2	
Drawing [p. 58]........		3	Drawing [p. 58]........		3
Machine Design			Steam Engines and Boilers		
Lectures [p. 65]........	1		Lectures [p. 65]........	1	
Drawing [p. 65].........		3	Drawing [p. 65]........		3
Metallurgical Chemistry [p. 73]................		6			
Electric Power Transmission			Electric Power Transmission		
Lectures [p. 68]........	2		Lectures [p. 68].........	2	
Laboratory [p. 68]......		3	Assaying		
Structural Materials Testing Laboratory [p. 57].		3	Lectures [p. 46].......	1	
			Laboratory [p. 46]......		9
Metallurgical Trips [p. 83]			Metallurgical Trips [p. 83].		
1. Iron and Steel Works.			1. Lead Smelter		
2. Sampling Plant			2. Zinc Smelter		
3. Smelting Plant, for the study of furnace types					

Mining Trip to Cripple Creek [p. 83].

The courses are described on the pages indicated after each course.

TABULAR VIEW.

METALLURGICAL ENGINEERING—Concluded.

Senior Year.

First Semester	Lect. Hr.	Lab. Hr.	Second Semester	Lect. Hr.	Lab. Hr.
Economic Geology [p. 53]..	3		Economic Geology [p. 53]..	3	
Ore Dressing					
Lectures [p. 47]........	3				
Laboratory [p. 47]......		3			
Metallurgy			Metallurgy		
Lectures: gold and silver [p. 48]...........	2		Administration [p. 49]..	1	
Laboratory [p. 48]......		3	Copper and metals not elsewhere treated [p. 48]...............	3	
Metallurgical Seminary [p. 50].................	1		Laboratory and Practice [p. 49]............		3
Electrometallurgy			Electrometallurgy		
Lectures [p. 50]........	2		Lectures [p. 50]........	2	
Laboratory [p. 50]......		3	Laboratory [p. 50]......		3
Power Plant Design [p. 65]			Metallurgical Plant Design		
Lectures	1		Lectures [p. 66].........	1	
Drawing		3	Drawing		3
Hydraulics [p. 59]........	2				
Compressed Air Machinery [p. 63].................	1		Metallography		
			Lectures [p. 51].........	1	
Mechanical Engineering Laboratory [p. 64]......		3	Laboratory [p. 51]......		3
Hydraulic and Cement Laboratory [p. 59]......		3	Contracts and Specifications [p. 60]...........	2	
Mining [p. 40]............	2		Mining [p. 40]...........	2	
Mine Examination and Reports [p. 41]...........	1		Economics of Mining [p. 41].................	2	
			Thesis		6
English [p. 82]...........	1		English [p. 82]...........	1	
Ore Dressing Trips [p. 83]			Metallurgical Trips [p. 83].		
1. Sampling Works			1. Copper Smelting		
2. Concentrating Plants.			2. Gold Milling Plant...		
3. Magnetic and Electric Separating Plants ..			3. Cyanide and Chlorination Mills		

Advanced Geological Field-Work [p. 53].

Senior Mining, Metallurgical, Engineering, and Geological Trip [p. 85].

The courses are described on the pages indicated after each course.

POSTGRADUATE DEPARTMENT.

Graduates of Colleges, Universities, or Engineering Schools of good standing, who have received the degree of A. B., Ph. B., B. S., M. E., E. E., or an equivalent degree, will be admitted to either of the following courses without examination, provided, in the judgment of the Faculty, their education and experience will enable them to carry the work successfully. The degree of E. M. (Mining Engineer) or E. Met. (Metallurgical Engineer) will be conferred on the completion of the appropriate course. Applicants who have already successfully completed any of the work of these courses will be allowed due credit for such work, and applicants who are deficient in any subject which naturally precedes any of the work in these courses will be required to make up such deficiency before receiving their degree.

Applicants should have completed an amount of work equivalent to that given in the Colorado School of Mines in the following subjects:

Algebra
Trigonometry
Analytic Geometry
Differential and Integral Calculus
Mechanics of Engineering
Plane Surveying and Field Work
General Chemistry
Qualitative Analysis
Descriptive Geometry and Drawing
Machine Design and Drawing
Steam Engines and Boilers and Drawing
Physics

TABULAR VIEW.

POSTGRADUATE COURSE—METALLURGICAL ENGINEERING.

First Year.

First Semester	Lect. Hr.	Lab. Hr.	Second Semester	Lect. Hr.	Lab. Hr.
Crystallography [p. 54]			Mineralogy [p. 54]		
Lectures	2		Lectures	2	
Laboratory		6	Laboratory		6
Metallurgy: general metallurgy, iron, and steel [p. 44]	5		Metallurgy: lead, antimony, bismuth, zinc, and cadmium [p. 45]	5	
Mining [p. 39]	3		Mining [p. 39]	3	
Mine Surveying [p. 38]	2		Mine Surveying [p. 38]	2	
Industrial Chemistry [p. 73]	2		Industrial Chemistry [p. 73]	2	
Quantitative Analysis [p. 72]			Metallurgical Chemistry [p. 73]		
Lectures	1		Laboratory		9
Laboratory		9			
*Electricity Applied to Mining [p. 69]			*Electricity Applied to Mining [p. 69]		
Lectures	2		Lectures	2	
Laboratory		3	Laboratory		3
Metallurgical Trips [p. 83]			Metallurgical Trips [p. 83]		
1. Iron and Steel Works.			1. Lead Smelter		
2. Sampling Plant			2. Zinc Smelter		
3. Smelter Plant, for the study of furnace types					

Mine Surveying: Field-Work [p. 39]. Four weeks in summer following the regular college year. One week is spent at Idaho Springs.

Mining Trips to Central City, Idaho Springs, Cripple Creek, and the Northern Colorado Coal Field [p. 83].

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*Starred courses are given only to postgraduates. Other courses are identical with the regular courses in the undergraduate schedule.

TABULAR VIEW.

POSTGRADUATE COURSE—METALLURGICAL ENGINEERING.

Second Year.

First Semester	Lect. Hr.	Lab. Hr.	Second Semester	Lect. Hr.	Lab. Hr.
Economic Geology [p. 53]	3				
Ore Dressing [p. 47]			Metallography [p. 51]		
Lectures	3		Lectures	1	
Laboratory		3	Laboratory		3
Metallurgical Seminary [p. 50]	1		Metallurgy		
Metallurgy: gold and silver [p. 48]			Administration [p. 49]	1	
Lectures	2		Copper and metals not elsewhere treated [p. 48]	2	
			*Rare Metals [p. 74]	2	
			Laboratory and Practice [p. 49]		3
Electrometallurgy [p. 50]			Electrometallurgy [p. 50]		
Lectures	2		Lectures	2	
Laboratory		3	Laboratory		3
Power Plant Design [p. 65]			Metallurgical Plant Design [p. 66]		
Lectures	1		Lectures	1	
Drawing		3	Drawing		3
Mining [p. 40]	2		Mining [p. 40]	2	
Mine Examination and Reports [p. 41]	1		Economics of Mining [p. 41]	2	
Assaying [p. 46]			Thesis		6
Lectures	1				
Laboratory		9			
Ore Dressing Trips [p. 83]			Metallurgical Trips [p. 83]		
1. Sampling Works			1. Copper Smelting		
2. Concentrating Plants			2. Gold Milling Plant		
3. Magnetic and Electric Separating Plants			3. Cyanide and Chlorination Mills		

Senior Mining, Metallurgical, Engineering, and Geological Trip [p. 85].

The courses are described on the pages indicated after each course.

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*Starred courses are given only to postgraduates. Other courses are identical with the regular courses in the undergraduate schedule.

TABULAR VIEW.

POSTGRADUATE COURSE—MINING ENGINEERING.

First Year.

FIRST SEMESTER	Lect. Hr.	Lab. Hr.	SECOND SEMESTER	Lect. Hr.	Lab. Hr.
Crystallography [p. 54]			Mineralogy [p. 54]		
Lectures	2		Lectures	2	
Laboratory		6	Laboratory		6
Metallurgy: general metallurgy, iron, and steel [p. 46]	3		Metallurgy: lead and zinc [p. 46]	3	
Mining [p. 39]	3		Mining [p. 39]	3	
Mine Surveying [p. 38]	2		Mine Surveying [p. 38]	2	
Quantitative Analysis [p. 72]			Assaying [p. 46]		
Lectures	1		Lectures	1	
Laboratory		9	Laboratory		6
*Electricity Applied to Mining [p. 69]			*Electricity Applied to Mining [p. 69]		
Lectures	2		Lectures	2	
Laboratory		3	Laboratory		3
Gas Engines [p. 64]	2		Industrial Chemistry [p. 73]	2	
Compressed Air Machinery [p. 63]	2		Pumping Machinery [p. 64]	2	
Metallurgical Trips [p. 83]			Metallurgical Trips [p. 83]		
1. Iron and Steel Works.			1. Lead Smelter		
2. Sampling Plant			2. Zinc Smelter		
3. Smelter Plant, for the study of furnace types					

Mine Surveying. Field-Work [p. 39]. Four weeks in summer following the regular college year. One week is spent at Idaho Springs.

Mining Trips to Central City, Idaho Springs, Cripple Creek, and the Northern Colorado Coal Field [p. 83].

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*Starred courses are given only to postgraduates. Other courses are identical with the regular courses in the undergraduate schedule.

TABULAR VIEW.

POSTGRADUATE COURSE—MINING ENGINEERING.

Second Year.

First Semester	Lect. Hr.	Lab. Hr.	Second Semester	Lect. Hr.	Lab. Hr.
Advanced Geology [p. 53]	4		Lithology [p. 55]		
			Lectures	2	
			Laboratory		3
Economic Geology [p. 53]	3		Economic Geology [p. 53]	3	
Mining [p. 40]	2		Mining [p. 40]	2	
Mine Examination and Reports [p. 41]	1		Economics of Mining [p. 41]	2	
Mining Laboratory [p. 42]		3	Mining Laboratory [p. 42]		3
Power Plant Design [p. 63]			Mine Plant Design [p. 63]		
Lectures	2		Lectures	2	
Drawing		6	Drawing		3
*Mine Plant Testing [p. 66]			*Mine Plant Testing [p. 66]		
Lectures	1		Lectures	1	
Laboratory		3	Laboratory		3
Ore Dressing [p. 47]			Metallurgy: gold, silver and copper [p. 49]		
Lectures	3		Lectures	2	
Laboratory		3	Laboratory and Practice [p. 49]		3
Thesis		3	Thesis		3
Ore Dressing Trips [p. 83]			Metallurgical Trips [p. 83]		
1. Sampling Works			1. Copper Smelter		
2. Concentrating Plants			2. Gold Milling Plant		
3. Magnetic and Electric Separating Plants			3. Cyanide and Chlorination Mills		

Geology. Advanced Field-Work [p. 53].

Senior Mining, Metallurgical, Engineering, and Geological Trip [p. 85].

The courses are described on the pages indicated after each course.

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*Starred courses are given only to postgraduates. Other courses are identical with the regular courses in the undergraduate schedule.

ADDITIONAL POSTGRADUATE COURSES.

The following courses are offered to aid advanced students who desire to specialize along particular lines of applied science. They are open only to postgraduate students.

Coal Mining	Professor Hoskin	[p. 42]
Coal Testing	Professor Cronin	[p. 67]
Advanced General Metallurgy	Professor Traphagen	[p. 51]
Gas Engine Design	Assistant Professor Otis	[p. 67]
Kinematical Drawing of Mining Machinery	Assistant Professor Briggs	[p. 67]
Advanced Mine and Mill Design	Professor Allison	[p. 60]
Advanced Hydraulic Design	Professor Allison	[p. 60]
Ceramic Geology	Assistant Professor Butler	[p. 53]
Cements and Clays	Assistant Professor Bailar	[p. 73]
Chemistry of the Rare Metals	Professor Fleek	[p. 74]
Radio-activity and Spectroscopy	Assistant Professor Miller	[p. 77]
Practical Astronomy	Professor Burger	[p. 81]
Precise Surveying and Geodesy	Professor Burger	[p. 81]
Microscopic Petrography	Professor Patton	[p. 55]

MINING.

PROFESSOR ARTHUR JOSEPH HOSKIN.
ASSISTANT PROFESSOR ALWYN CHARLES SMITH.

The courses in this department are designed to instruct the student in the theory and practice of mineral land and underground surveying; in the application of the sciences to the art of mining; in the principles and applications of the power machinery used in the mineral industry; in the best methods, practices and ethics of mining engineers and mine managers.

I. MINE SURVEYING. *Lectures.*

This course covers the practical phases of the duties of a U. S. Mineral Surveyor. Lectures are given upon the legal requirements in locating and patenting mineral ground. Actual and imaginary cases are taken up and the practical work of putting them through the various steps is performed. The school is well situated for the field course which supplements the class-room work. The student is given sufficient field experience to render him familiar with the approved methods of surveying lode, placer, tunnel site, and mill-site claims. Complete field notes are taken of problems assigned in the field. These are subsequently put through the office calculations and a complete set of documents prepared for filing in the offices of the U. S. Surveyor General and the Land Office. The theory and practice of determining the meridian and latitude from direct solar observation are included in this course.

Prerequisites: Mechanical Engineering, I. and II.
Mathematics, I. to IV. inclusive.
Civil Engineering, I. and II.

Texts: Underhill, *Mineral Land Surveying.*

Two hours per week during the first semester of the Sophomore year. (A. C. Smith.)

II. MINE SURVEYING. *Lectures.*

Attention is given to the practices of underground surveying. Instruction is given in carrying meridians into mines, laying out workings, keeping notes, estimating areas and tonnage, and in the many other duties which are assigned to a mining engineer. Surveying with hand transits and with auxiliary telescopes is taught. The organization of field parties is handled. The determination of dip and strike of ore or coal bodies from drill-hole data, and various methods of locating mine openings for the advantageous opening, development, drainage, haulage, and production of mines are emphasized. The platting of notes and the construction of maps are important subjects taught.

Prerequisite: Course I.

Two hours per week during the second semester of the Sophomore year. (A. C. Smith.)

III. MINE SURVEYING. *Field-Work.*

Each student is given personal instruction and practice in the survey of mines and mining claims. The squads are limited in size in order that each man may learn all the details of the work and appreciate the importance of every phase of the subject. Among the problems assigned are the following: the complete survey of a mining claim; the survey and mapping of an actual metal mine; the complete survey and mapping of a property, including claims, buildings, and mine workings.

Prerequisites: Courses I. and II.

Four weeks in the summer following the regular work of the Sophomore year. One week is spent at Idaho Springs.

(Hoskin, A. C. Smith.)

IV. MINING.

This course is given as an introduction to the study of the broad subject of mining, which, in its more detailed and practical features, is taken up in the succeeding courses. The history of the industry; its importance on civilization; the economic geology of coal and ore bodies; prospecting for the various minerals of commercial value; the natural occurrence of such minerals; placering; the famous mines and districts of the world; and the chief characteristic of prominent mines, both in the past and at the present time, are among the topics which are taught.

Emphasis is laid upon the fact that one can keep up to date in mining matters only by the continual perusal of current literature: for this reason frequent reference is made to the latest book and magazine publications regarding the continually changing theories and methods. No text books are required.

Prerequisites: Completed work of the Freshman year.
Courses I., II. and III.
Mineralogy I. and II.

Three hours per week during the first semester of the Junior year. (Hoskin, A. C. Smith.)

V. MINING.

This course covers the systems that are employed in opening and extracting all kinds of ore or coal deposits. The general subjects considered are: surface mining; underground metal and coal mining; shaft and winze sinking; tunneling; drifting; upraising; stoping and timbering.

Among the subjects considered in detail are: milling; steam shovel practices; stripping; blocking out bodies; the enlarging of tunnels from small headings; sinking under varying conditions; underhand and overhead stoping; the extraction of wide, narrow, steep and flat deposits; sluicing; caving; filling; the properties and preservation of wood; stick and square set timbering; the framing and placing of timbers in shafts, inclines, tunnels and stopes; and the use of steel and reinforced concrete as supports.

No text books are required.

Prerequisite: Course IV.

Three hours per week during the second semester of the Junior year. (Hoskin, A. C. Smith.)

VI. MINING.

With this course, begins the study of the practical operations, as distinguished from the systems, involved in the operations of mining. The course covers boring, drilling, blasting, hoisting and haulage. Some of the subjects to receive detailed attention are: core and churn drills; the distinctive features of the different makes and types of rock drills; the systematic placing and drilling of holes; the proper loading and firing of shots; the causes of failure or accident in the use of explosives; the manufacture, use, and repair of steel cables; the types of hoisting engines; hoisting in balance; electric, steam, and compressed air mine locomotives; and the operating costs of these operations.

Frequent use is made of trade catalogues.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses IV. and V.

Text: Gillette, *Rock Excavation.*

Two hours per week during the first semester of the Senior year. (Hoskin.)

VII. MINING.

The aim of this course is to cover all the practical subjects not previously studied. Among these subjects are: drainage; the evolution of mine pumps; the composition and occurrence of mine gases; the ventilation requirements of men and animals; the natural and artificial means of furnishing fresh air to mine workings; the theories and types of mine fans; the use of candles and oil, acetylene and electric lamps underground; the inherent hazards in mining; mortality statistics; statutory provisions; rescue methods; and signal codes.

At the conclusion of this course, students are permitted to suggest topics which will be discussed as fully as the time will permit. The lecture room work is planned with a view to making the Senior trip of the greatest benefit, and for this reason, particular attention is given to the features of the districts to be visited.

No text books are required.

Prerequisite: Course VI.

Two hours per week during the second semester of the Senior year. (Hoskin.)

VIII. MINE EXAMINATIONS AND REPORTS.

In this course, the detailed study of the practices of leading mining engineers throughout the world, in the examination, sampling, and reporting of mining properties, is handled by text book and lectures. Numerous actual reports of reputable engineers are exhibited. Discussions are held, by members of the class, regarding the details of the field operations, the materials to be embodied in the subsequent reports, the ethics to be maintained by examining engineers, and the most reliable methods of estimating tonnages and values.

Printed outlines of suggestive points to be ascertained during the process of examining a property are distributed and the separate items critically considered.

Among the subjects treated are: the work, cost, precautions, and calculations of sampling a mine; the inferences to be made from varying samples of the same mine; the estimation of ore reserves; and the various aspects of mine valuation.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses IV. and V.
This course must be taken in conjunction with or subsequent to Economic Geology.

Text: Rickard, *The Sampling and Estimation of Ore in a Mine.*

One hour per week during the first semester of the Senior year. (Hoskin.)

IX. ECONOMICS OF MINING.

In this course, such topics as the organization, operation and management of mines are taken up for careful, detailed study, with particular reference to the economic features. Emphasis is laid upon the necessity of carrying on mining operations in the same systematic and economic manner as any other commercial enterprise. Itemized accounts of prominent mines are studied.

Attention is given to the following subjects: prospectuses; mining stocks; "mining booms"; exploration companies; liabilities of employers; the efficiencies of labor and mechanical devices; forest reserve regulations; failures in mining; secrecy in operations and public reports; and profits.

Assignments or reference reading are made to members of the class. To give students the opportunity of entering into general discussions, occasional seminaries are held.

Prerequisite: Course VIII.

Text: Rickard, *Economics of Mining.*

Two hours per week during the second semester of the Senior year.

X. MINING LABORATORY. (Mining Engineering Course only.)

The college has equipped a complete shop about three-quarters of a mile west of the campus upon the slope of Mount Zion, at the mouth of the tunnel which is being driven by the students. In this practical work, experience is obtained in handling all kinds of rock drills; in shaping, sharpening and tempering steels; in blasting, mucking, and tramming; in tracklaying and timbering; and in performing all the usual tasks incident to actual tunneling. Compressed air and electricity are furnished from the power plant of the college. Arrangements are made so that students can make efficiency tests upon the various makes and kinds of drills handled.

Prerequisites: Course VI.
Mechanical Engineering, Course XII.

The equivalent of three hours per week during the second semester of the Senior year. (Hoskin, Smith.)

XI. COAL MINING. (Optional.)

This course is planned to cover many of the features and operations of coal mining not included in the other courses. Special attention is given to such subjects as the prospecting for and the development of coal properties; the construction. use, efficiency, and cost of the various types of coal-cutting machines; and the special features of economic geology, hoisting, timbering, haulage, ventilation and drainage as encountered in the practice of mining coal.

The course is intended primarily for postgraduates, but is open to Seniors; however, if undertaken, it must be carried on with the same regularity that is attached to a required course.

No text books are required, but reference is made to the latest literature along the lines studied in the lecture room.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses IV. and V.

Two hours per week during the first semester of the Senior year. (Hoskin.)

XII. COAL MINING. (Optional.)

In this lecture course, the subjects studied are: the design, erection, and maintenance of coal plants and equipments; the surface handling, weighing, screening, washing, loading and disposal of coal mine products; the keeping of records; the occurrence and prevention of explosions and other calamities; wage and contract system; and the successful handling of coal mine labor.

The subjects enumerated in Courses XI. and XII. are taught in such practical detail that the graduate will be able to manage successfully any kind of a coal mine.

This course is intended primarily for postgraduates, but is open to Seniors.

No text books are required.

Prerequisite: Course XI.

Two hours per week during the second semester of the Senior year. (Hoskin.)

XIII. MINING LAW. (Optional.)

This is an optional course presented by special lecturers who are experienced attorneys with practice in mining law. Beginning with a historical review of the growth of our present laws relating to mining, the course covers every feature of general interest to the practicing mining engineer.

This course is open only to Seniors.

Two lectures per month throughout the Senior year.

METALLURGY.

PROFESSOR FRANK WEISS TRAPHAGEN.
ASSISTANT PROFESSOR WILLIAM GEORGE HALDANE.
FELLOW, SIDNEY WILLIS FRENCH.

The aim of this department is to provide a foundation for practical work in metallurgy. In the lecture room attention is constantly directed to the principles involved in the treatment of ores, especially to chemical reactions and the influence of mass, temperature, and other conditions upon these changes. In the laboratory, metallurgical operations are given a critical study, and all the resources of the chemical and assay laboratories are drawn upon. The purpose is to equip the college with working size apparatus, illustrating the different types of metallurgical and ore dressing plants, and to have these operated by students, who will check each operation by careful tests in the laboratories.

I. METALLURGY. *General Metallurgy, Iron and Steel.*

(Metallurgical Engineering Course only.)

GENERAL METALLURGY. This course involves, first, a general study of the fundamental metallurgical principles, and, as an extension of the work on fuels, deals with such calculations as air required for combustion, the calorific value of solid, liquid and gaseous fuels, weight of the products of combustion, heat carried off by flue gases, and maximum temperatures. Following this, the subjects of pyrometry, with the modern methods of high temperature measurements, and calorimetry, with various methods of determining the heat value of fuels, are studied. Consideration is then given to the principles involved in the various types of metallurgical furnaces, and comparisons made.

IRON AND STEEL. The development of the metallurgy of iron, and the general application of labor saving devices, together with the fundamental principles involved in smelting, makes it necessary to study these metals first.

The subject is treated in the following order: ores of iron; metallurgical chemistry of iron; blast furnaces; construction: reactions occurring in the operation; hot blast stoves; dust catchers and other accessories; utilization of blast furnace gases; calculation of the furnace charge; wrought iron, production and treatment by direct and indirect methods, including a study of puddling furnaces, forge and mill machinery.

STEEL. Acid and basic open hearth, acid and basic Bessemer processes are considered in detail, and the cementation process and manufacture of crucible steel taken up at some length.

Prerequisites: Completed work of the Freshman year.
Chemistry, VII. to XII. inclusive.
Physics, I. to IV. inclusive.
Mineralogy, I. and II.

References: Richards, *Metallurgical Calculations.*
Greenwood, *Iron and Steel.*
Stoughton, *Iron and Steel.*

Five hours per week during the first semester of the Junior year. (Haldane.)

II. METALLURGY. *Lead, Antimony, Bismuth, Zinc, Cadmium.*
(Metallurgical Engineering Course only.)

LEAD. The metallurgy of lead is considered in the following order: properties of lead and its compounds; ores of lead; sampling and purchasing of lead ores; fluxes and fuel; reverberatory smelting; smelting in the ore hearth; roasting of ores, including the chemistry of the roasting process; blast furnace smelting, including construction; chemistry of the blast furnace; calculation of furnace charges; treatment of products; softening, desilverization, and refining of base bullion; Pattinson process; Parkes process; German and English cupellation.

ANTIMONY. Because this metal is so closely allied to lead, its metallurgy very properly follows that of the latter. The extraction of the metal from its ores, and the refining of the product by present methods are discussed at length, while considerable attention is given to the principal antimonial alloys and furnace products in which it is found.

BISMUTH. The several processes for the extraction of bismuth from its ores and metallurgical products are dealt with in detail, together with the approved methods of refining the product.

ZINC. This course comprises a study of the following topics: calcination; roasting and distillation by various methods, including a detailed study of furnace types, direct fired, semi-gas and gas fired; manufacture of retorts; refining of spelter and general cost of production.

CADMIUM. The lectures on this topic deal with the subject as follows: source of ores; wet and dry extraction; electrolytic methods.

On account of its similarity to zinc the work follows immediately after the latter in the course.

Prerequisite: Course I.

References: Hofman, *Metallurgy of Lead.*
Ingalls, *Metallurgy of Zinc and Cadmium.*
Schnabel, *Hand-book of Metallurgy.*

Five hours per week during the second semester of the Junior year. (Haldane.)

III. METALLURGY. *General Metallurgy, Iron and Steel.*
(Mining Engineering Course only.)

This course is somewhat similar to Course I. The plan followed is to study only the fundamentals involved in these metallurgical operations, and to give the student a general idea of general metallurgy, and the manufacture of iron and steel.

Prerequisites: Completed work of the Freshman year.
Chemistry, VII. to XII. inclusive.
Physics, I. to IV. inclusive.
Mineralogy, I. and II.

References: Richards, *Metallurgical Calculations.*
Stoughton, *Iron and Steel.*
Greenwood, *Iron and Steel.*

Three hours per week during the first semester of the Junior year. (Haldane.)

IV. METALLURGY. *Lead and Zinc.*
(Mining Engineering Course only.)

This course comprises a general study of lead smelting, including ores, sampling, roasting and subsequent treatment in blast furnace and methods of desilverizing and refining. A short lecture course on the metallurgy of zinc is given after the completion of the work in lead.

Prerequisite: Course III.

Reference: Hofman, *Metallurgy of Lead.*
Ingalls, *Metallurgy of Zinc.*

Three hours per week during the second semester of the Junior year. (Haldane.)

V. ASSAYING.

Special attention is directed toward making this course as practical as possible, and, while the importance of accurate work is at no time lost sight of, constant efforts are made to enable the student to handle a large amount of work in as short a time as possible. As nearly as may be, the student is put under smelter conditions, and is early made familiar with the system prevailing in the best conducted laboratories, so that in the end he may be able to take his place at once in such a laboratory without undergoing a "breaking-in" course after leaving school.

The work includes all the assays called for in the laboratory of mine, mill, or smelter, and the methods, besides those in use so satisfactorily for many years, include also such "short cuts" as have been introduced by assayers having several hundred assays to make daily. The course covers the following: the fusibility of slags of definite composition made up by careful calculation; the fluxing of limestone ores and silicious ores for practice; the running of lead mixtures of known lead, silicia and base content to determine the influence of foreign elements and variable gangue; the assay of sulphide and oxide ores of lead; the assay of gold and silver ores of different types by various methods, with a comparison of results; the assay of zinciferous and cupiferous gold and silver ores; of arsenical and antimonial ores; the crucible and scorification assay of mattes and concentrates; the assay of gold, silver and base bullions, of tin and platinum ores and special assays, especially of cyanide solutions and products.

Prerequisite: The completed work of the Freshman and Sophomore years, with the exception of Mine Surveying.

One lecture and six hours' laboratory work per week during the first semester of the Junior year for the Mining Engineering Course, and one-hour lecture and nine hours' laboratory work during the second semester of the Junior year for the Metallurgical Engineering Course. (Traphagen, Haldane, French.)

VI. ORE DRESSING. *Lectures.*

The following represent the main divisions under which this subject is studied; jaw and gyratory breakers; rolls; stamps, gravity, steam and pneumatic; special crushing and fine grinding apparatus; apparatus for sizing, including the various types of screens and classifiers; the actual concentrating machines, including jigs, tables and vanners.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses I., II. and V., or III., IV. and V.

Reference: Richards, *Ore Dressing.*

Three hours per week during the first semester of the Senior year. (Traphagen.)

VII. ORE DRESSING. *Laboratory.*

The work consists of sizing tests of the products of various crushers and operations, concentrating by panning and by various mechanical devices, and comparative studies of the different forms of commercial sizing, classifying, and concentrating devices. The principles underlying the action of classifying and concentrating devices receive careful consideration.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses I., II. and V., or III., IV. and V.

Three hours per week during the first semester of the Senior year. (Traphagen, Haldane, French.)

VIII. METALLURGY. *Gold and Silver.*

(Metallurgical Engineering Course only.)

This course covers the following: metallurgy of gold and silver, including stamp milling, cyanidation, and chlorination of gold ores; chloridizing roasting, and amalgamation of silver ores; the Russell process and other wet methods for silver; the parting of gold and silver bullion by various commercial methods, with special attention to electrolysis and the sulphuric acid treatment. The various modifications of the cyanide process receive particular attention, especially the treatment of the slimes from zinc precipitation; the Moore filter process; the regeneration of the cyanide; the different methods proposed for precipitating the dissolved gold and the recent application of the process to silver ores.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses I., II. and V.

References: Rickard, *Stamp Milling or Gold Ores.*
Park, *The Cyanide Process.*
Julian and Smart, *The Cyanide Industry.*

Two hours per week during the first semester of the Senior year. (Traphagen.)

IX. METALLURGY. *Copper and Metals not considered elsewhere.*

(Metallurgical Engineering Course only.)

COPPER. A critical study of the principles of copper metallurgy as covered by the best modern practice, including roasting of ores. blast and reverberatory smelting, pyritic smelting, converting of matte, refining of copper, treatment of oxidized ores, and hydrometallurgical methods.

Other metals considered in this course are cobalt, nickel, mercury and tin.

Prerequisite: Course VIII.

References: Peters, *Modern Copper Smelting.*
Peters, *Principles of Copper Smelting.*

Three hours per week during the second semester of the Senior year. (Traphagen.)

X. METALLURGICAL LABORATORY.

(Metallurgical Engineering Course only.)

This course includes optical pyrometers; Junker, Bomb, and Parr calorimeters; testing refractory materials for fusibility; influence on refractory power of various elements: thermal gradient; various experiments with iron and steel; microstructure of steel.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses I., II. and V.

Laboratory Manual: Howe, *Metallurgical Laboratory Notes.*

Three hours per week during the first semester of the Senior year. (Haldane, French.)

XI. METALLURGICAL LABORATORY.

This course covers the comparative treatment of ores by amalgamation, chlorination, and cyanidation. Special emphasis is laid on the difficulties of treatment and methods of overcoming such difficulties. Copper selecting process, chloridizing roasting, and hydrometallurgical treatment of copper and other ores are also considered.

Prerequisites: Courses VI. and VII.

Three hours per week during the second semester of the Senior year. (Traphagen, Haldane, French.)

XII. METALLURGICAL PRACTICE.

This course covers the operation of commercial size machines of the various types used in practical metallurgy, including crushing and concentration, stamp milling, roasting and smelting of ores, cyanide and chlorination practice.

Prerequisites: Courses VI. and VII.

The equivalent of three hours per week during the second semester of the Senior year. (Traphagen, Haldane, French.)

XIII. METALLURGY. *Gold, Silver and Copper.*

(Mining Engineering Course only.)

Gold and Silver. Lectures on amalgamation, chlorination, and cyanidation of gold ores, on pan amalgamation, and lixiviation of silver ores, and on the adaptation of methods to the treatment of specific ores.

Copper. The modern methods for the treatment of copper ores are considered. Attention is especially directed to present blast furnace and reverberatory practice, to the converting of matte and the refining of copper.

Prerequisites: Courses VI. and VII.

References: Peters, *Principles of Copper Smelting.*

Two hours per week during the second semester of the Senior year. (Traphagen.)

XIV. METALLURGY. *Administration.*

(Metallurgical Engineering Course only.)

A series of lectures covering the various practices followed in the division of the work of plants and the handling of men, together with a study of the systems of keeping accounts and of reporting results.

Prerequisite: Course VIII.

One hour per week during the second semester of the Senior year. (Traphagen.)

XV. METALLURGY. *Seminary.*

(Metallurgical Engineering Course only.)

Weekly meetings are held for the consideration of current journal articles on metallurgy, the discussion of thesis work, and practice in abstracting of papers.

Prerequisites: Courses I., II. and V.

One hour per week during the first semester of the Senior year.

(Traphagen.)

XVI. ELECTROMETALLURGY.

(Metallurgical Engineering Course only.)

This course is divided into two parts and covers the following subjects:

1. The phenomena of electrolysis.
    - (a) Measurement of the resistance and conductivities of electrolytes.
      Liquid and fused electrolytes.
    - (b) Temperature effects.

  Osmosis.

  The principles underlying the transformation of electrical and chemical energy.
    - (a) Electromotive forces and heats of combinations.
    - (b) Thermo-electromotive effects.

  Principles of electrical heating.
    - (a) Conduction and radiation.
    - (b) Efficiency of transformation of electrical energy into heat.

Lectures two hours, laboratory three hours, per week for the first nine weeks of the first semester of the Senior year.

(Miller.)

2. The estimation of the metals; copper, mercury, silver, zinc, tin, antimony, arsenic, lead, and the separation of metals.

Lectures two hours, laboratory three hours, per week during the last nine weeks of the first semester of the Senior year.

(Test.)

Prerequisites: The completed work of the Freshman and Sophomore years.
Courses I. and II., or III. and IV.

XVII. ELECTROMETALLURGY.

(Metallurgical Engineering Course only.)

This course is divided into two parts and covers the following subjects:

1. The electrolytic refining of metals and the parting of gold and silver bullion.

Lectures two hours, laboratory three hours, per week during the first six weeks of the second semester of the Senior year.

(Traphagen.)

2. Electric Furnace.

Types; efficiencies; advantages; comparison of electric furnace methods with the ordinary fire methods; ferro alloys; aluminum; carbides; graphite.

Lectures two hours, laboratory three hours, per week during the second six weeks of the second semester of the Senior year.

(Haldane.)

Prerequisite: Course XVI.

XVIII. METALLOGRAPHY.

(Metallurgical Engineering Course only.)

This course comprises a study of the general methods of investigating metals and alloys; the experimental determination and plotting of cooling curves; the physical mixture, including a consideration of aqueous solutions, fused salts and alloys, and a discussion of freezing point curves and diagrams. The preparation of the sample and development of the structure by various etching media. The use of the microscope and methods of making microphotographs are then taken up.

Following a study of the constitution and microstructure of iron and steel and the industrial alloys as influenced by heat treatment, considerable time is spent in the investigation of mattes speises, bullions, and other metallurgical furnace products.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses VI. and VII.

References: Goerens, *An Introduction to Metallography.*

Lecture one hour, laboratory three hours, per week during the second semester of the Senior year.

(Haldane.)

XIX. ADVANCED GENERAL METALLURGY. (Optional.)

This course comprises a study of metallurgical processes in the light of a good fundamental knowledge of the subject, with the object of gaining a thorough grasp of the underlying principles of metallurgical sciences. It covers the following subjects: slag and slag formations suitable to different processes, their chemical properties, formation temperatures, melting points, and other properties; a detailed study of the metallurgy of copper, with particular reference to pyritic smelting and converting of copper matte; advanced work in the metallurgy of the precious metals, with special attention to ores difficult of treatment and to the use of recovery methods in the cyanide process.

Open only to postgraduates.

Three hours laboratory per week with assigned reading during the first semester. (Traphagen.)

GEOLOGY AND MINERALOGY.

PROFESSOR HORACE BUSHNELL PATTON.
ASSISTANT PROFESSOR G. MONTAGUE BUTLER.
ASSISTANT PROFESSOR CHARLES EDWARD SMITH.

The college is very fortunately situated for the geologist. The surrounding formations not only present the strikingly clear features so characteristic of the West, but occur in great profusion and variety. In addition certain features peculiar to this particular location afford sufficiently complicated problems to be of great value to the student of geology. It is possible, therefore, without going more than a mile or two from the school to illustrate very effectively most geological problems; and field geology can be carried on at the same time with class instruction.

The subjects presented are classified under three heads: A, Geology; B, Mineralogy; C, Lithology.

A. GEOLOGY.

I. GENERAL GEOLOGY.

This course is intended as a preliminary one and is a preparation for the more advanced course given in the Junior year. It discusses general geological principles more particularly in connection with dynamical, structural, and physiographic geology. The course is essentially a lecture course based on a text book. In connection with this course four field trips are required. These trips are taken for the purpose of emphasizing the importance of scientific observation. The attention of the class is called to the processes now active and to structures which have resulted. A neatly written report is required after these subjects have been treated in regular lectures.

Prerequisite: Entrance requirements.

Text: Norton, *Elements of Geology*.

Three hours per week during the first semester of the Freshman year. (C. E. Smith.)

II. GEOLOGICAL FIELD-WORK.

This course is intended to give the student the mechanics of geological field-work. He is made acquainted with the application of field instruments in common use by the geologist, namely, the plane table, compass, aneroid barometer and hand level, and with methods of field-work and note taking.

Prerequisites: Course I.
Civil Engineering I. and II.

Eight afternoons, or their equivalent, during the first semester of the Sophomore year. (C. E. Smith, Patton, Butler.)

III. ADVANCED GEOLOGY.

This course is a continuation of Course I., and is given by means of lectures and text-book work. It deals mainly with stratigraphic and historical geology, with special reference to American areas.

Prerequisite: Completed work of the Freshman year.

Four hours per week during the first semester of the Junior year. (Butler.)

IV. ADVANCED GEOLOGICAL FIELD-WORK.

This course embraces mainly field-work in areal geology. Each student is assigned a particular section which he is to study, map, and report upon. This throws the student upon his own resources and gives him not only further practice in geological observation, but also the necessary training for preparing reports based upon his own observations.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses I., II. and III.

Four full days in the field, or their equivalent, during the first semester of the Senior year. (Butler, C. E. Smith, Patton.)

V. ECONOMIC GEOLOGY.

This course discusses the matter of ore deposits, their nature, occurrence and origin, especially the ores carrying the precious metals. Attention is also given to other natural products of economic value, such as coal, petroleum, and building stones.

Prerequisites: Completed work of the Freshman and Sophomore years.
Lithology I.
Geology III.

Three hours per week throughout the Senior year. (Patton.)

VI. CERAMIC GEOLOGY. (Optional.)

This course is intended to enable the student to find, to classify properly, and to quarry or mine the raw materials of the ceramic art. Emphasis is placed upon the geology of the subject rather than upon the details of manufacture of the clay products. Only the peculiar features and requirements of each line of manufacture are presented. The following subjects are discussed: the classification of clays and allied substances, their physical character and recognition in the field, including a discussion of distinctive properties; the necessary tests and chemical distinctions; the geological and geographical distribution of clays; the nature and cost of mining and quarrying operations; the value of, and market for, the various varieties; the uses of clays and the manufacture of clay products; securing government title to clay land; examining and reporting upon clay deposits.

Laboratory and field work three hours per week during the first semester.

Open only to postgraduates. (Butler.)

B. MINERALOGY.

I. CRYSTALLOGRAPHY.

This course is treated as an essential part of the general work in mineralogy, and only such portion of the subject is especially emphasized as is of practical value in the determination and the proper understanding of minerals. A very thorough drill, however, is given in the more practical portions of the subject. The course is presented through lectures, text books, and practical laboratory work; also by individual quizzes. In connection with the laboratory work each student is required to become thoroughly familiar with crystal forms and combinations such as are found on the usual wooden crystal models, and to determine with the aid of a pocket lens and contact gonimeter the crystal forms of three hundred crystals.

Prerequisites: Entrance requirements.

Text: Patton, *Lecture Notes on Crystallography.*

Lecture two hours, laboratory six hours per week, during ten weeks of the first semester of the Sophomore year.

(Patton, Butler, C. E. Smith.)

II. DETERMINATIVE MINERALOGY.

This course begins about the middle of November with a drill for five weeks in the methods of blowpipe analysis, with a view to preparing the student for the practical determination of minerals. This is followed by determinative mineralogy proper, which continues until the close of the second semester of the Sophomore year.

In this course about two hundred and fifty of the most important mineral species are presented by lectures, in which special emphasis is laid on the recognition of minerals by means of their physical properties and crystal forms. The object constantly kept in mind is not the training that will enable one to determine any mineral whatever, but rather to recognize at sight such minerals as are likely to be met in connection with mining operations. This is what the average mining engineer is expected to do. With this object in view, as thorough a drill as the time will allow is given in the actual handling and determining of minerals in the laboratory. In this work each student is expected to handle, determine, and be examined on, approximately two thousand five hundred individual specimens.

Prerequisites: Chemistry, I. to VI. inclusive.
Mineralogy, I.

Text: Moses and Parsons, *Mineralogy, Crystallography and Blowpipe Analysis.*

Lectures two hours, laboratory six hours per week, from the middle of November to the close of the second semester of the Sophomore year. (Patton, Butler, C. E. Smith.)

C. LITHOLOGY

I. LITHOLOGY.

This is a lecture course supplemented by laboratory work. The object is to present all the more commonly occurring rocks in such a way as to render their identification at sight reasonably accurate. The methods pursued are purely those applicable to the hand specimen without the aid of microscopic sections. The collection of the school is especially rich in those rocks that are usually encountered in mining operations in Colorado and adjacent states. Special emphasis, therefore, is laid upon such rocks and upon their various alteration forms.

Prerequisites: Completed work of the Freshman year.
Geology, I. and III.
Mineralogy, I. and II.

Text: Kemp, *Handbook of Rocks.*

Lecture two hours, laboratory three hours per week during the second semester of the Junior year.

(Patton, Butler, Smith.)

II. MICROSCOPIC PETROGRAPHY. (Optional.)

In this course the study of rocks and of rock-forming minerals is carried on with the help of the petrographic microscope. It covers (a) the study of the optical properties of minerals with a view to their identification, and (b) systematic petrography or the identification of rock types by means of their structures and mineral components.

Open only to postgraduates.

Six hours laboratory per week during the first semester.

Prerequisites: Mineralogy, I. and II.
Lithology, I. (Patton.)

CIVIL ENGINEERING.

Professor William Franklin Allison.
Assistant Professor William Jonathan Hazard.

The aim of this department is to prepare the student to make all the necessary surveys, calculations, and estimates that the mining and metallurgical engineer may be called upon to make, and at the same time to give him such a knowledge of plane surveying as will enable him to undertake any of the work that the surveyor is called upon to do in land, city, topographical, and railroad surveying.

I. PLANE SURVEYING. *Lectures.*

Instruction is given by lectures and recitations in the theory, construction, use and care of the surveyor's instruments of precision. The work includes the adjustment of instruments; the theory and use of the barometer, planimeter and plane-table; the principles of land, city, topographical, and railroad surveying, and the determination of the true meridian by means of various solar attachments and by direct observation of the sun and of circumpolar stars.

Prerequisites: Mathematics, Courses I. and II.
Mechanical Engineering, Courses I. and II.

Text: Raymond, *Plane Surveying.*

Two hours per week during the second semester of the Freshman year. (Allison, Burger.)

II. PLANE SURVEYING. *Field-Work.*

This course includes adjusting instruments; traverse surveying; observations and calculations for determining distances, areas and volumes; observations for the location of the meridian; the ordinary problems in city surveying; stadia work in connection with a topographical survey of some section near Golden. A short railway line is located, cross-sectioned, and the earthwork computed.

Prerequisites: Course I.
Mathematics I. and II.
Mechanical Engineering I. II. and IV.

Texts: Pence and Ketchum, *Surveying Manual.*
Searles, *Field Engineering.*

This course occupies four full weeks following the completion of the Freshman year. (Allison.)

III. MECHANICS OF ENGINEERING.

The course consists of the theoretical study of mechanisms and materials, embracing statics of a material point and of rigid bodies; chains, cords and cables; stresses and strains; tension, shearing, compression; torsion, flexure; combined torsion and flexure; elastic curves; safe loads; oblique forces; long columns and continuous beams. The student becomes familiar with the fundamental ideas of the motions of bodies, initially treating the dynamics of a material point with extensions of the theory to finite bodies. The fundamental differential equations of rectilinear motion are developed, and practical applications are found in the case of falling bodies, upward throw, and uniformly and variably accelerated bodies. Newton's laws are the basis of these latter items and also of the hypothetical "Engineers' Mass."

Prerequisites: Completed work of the Freshman year.
Mathematics, Courses V. to VII. inclusive.

Texts: Church, *Mechanics of Engineering.*
Church, *Notes and Examples in Mechanics.*
Problem Sheets.
Cambria Steel.

Three hours per week during the first semester of the Junior year. (Allison.)

STRUCTURAL MATERIALS.

IV. TESTING LABORATORY.

This course acquaints the student with the difficulties attending the practical application of theory. It emphasizes systematic and logical presentation, shows the importance of small details, secures data for future use, and provides a criterion as to the value of a student in his profession. Tests are made to determine the strength and stiffness of building materials such as cast-iron, wrought-iron, steel, and wood in tension, compression, shearing, and flexure. Stone and brick are examined for strength, absorption, disintegration, and other qualities which decide their economic values. The correct dimensioning and surfacing of specimens also forms an integral part of the course. Steel forms are submitted to the students for the determination of the centers of gravity and the moments of inertia. Written reports covering the apparatus, procedure, data, computation, results, and conclusions, are required from each student.

Prerequisite: This course must be taken in conjunction with Course III.

Three hours per week throughout the Junior year. (Hazard.)

V. MECHANICS OF ENGINEERING.

This course is an extension of Course III. Virtual velocities introduce the first elements of the principles of work and energy and serve as a basis of discussion in the treatment of the curvilinear motion of a material point which follows. Under this latter head the general equations and principles of curvilinear motion are derived and then applied to simple and cycloidal pendulums, to planetary motion, to a projectile in vacuo, to a body on smooth curved guide, and to absolute and relative velocities. A study of rotating bodies, compound pendulums, rudimentary engines, fly-wheels, eccentric pulleys, rolling bodies, parallel rod of locomotive, hoisting in mines, and the like, is made.

Prerequisites: Courses III. and IV.

Texts: Church, *Mechanics of Engineering.*
Church, *Notes and Examples in Mechanics.*
Problem Sheets.
Cambria Steel.

Three hours per week during the second semester of the Junior year. (Allison.)

VI. ENGINEERING CONSTRUCTION.

In this course instruction is given in graphical analysis of the stresses in the more elementary forms of framed structures and a comparison is made with the algebraic solutions of the same problems.

The student becomes familiar with the definitions of parts, such as housing, notching, mortise and tenon, dove-tailing, lag-screws, dowels and lugs, and, from accepted unit stresses, the student is led to design joints, splices, deepened beams, trussed beams, gallows frames and head frames from wood. A brief study is made of the ordinary timbers used in construction and the best modern methods of protecting them from the action of the elements and wood destroying insects. Some attention is given to riveted and pin-connected trusses of steel.

Prerequisites: Completed work of the Freshman year.
Mathematics, Course V. to VII. inclusive.
This course must be taken in conjunction with or subsequent to Course III.

Texts: Ketchum. *Steel Mill Buildings.*
Miscellaneous references.
Lecture notes.

Lectures two hours per week and drafting three hours per week during the first semester of the Junior year. (Allison.)

VII. MILL CONSTRUCTION.

This course is a study of theoretical and practical design of wooden and steel mill buildings and the uses of masonry in connection therewith. The general forms of such buildings are discussed and elementary ideas of ventilation, lighting, coverings, and the like are obtained. A wooden roof truss of accepted pattern is analyzed graphically and a detailed design is completed.

Steel mill buildings are thoroughly discussed, an analysis of all stresses involved is obtained and a complete design is required from each student. A suitable amount of time is given to the study of the materials used in masonry construction, such as brick, stone, lime, cement, plain and re-enforced concrete.

Prerequisites: Course VI.
This course must be taken in conjunction witb or subsequent to Course V.

Texts: Ketchum, *Steel Mill Buildings.*
Cambria Steel.
Miscellaneous references.
Lecture Notes.

Lectures two bours per week and design tbree hours per week during the second semester of the Junior year. (Allison.)

VIII. CEMENT LABORATORY.

The intent of this course is to familiarize the student witb the properties of cement so that he may not hesitate to utilize this material in bis professional work. The laboratory provides extensive opportunities for research and investigation. The course covers tests for natural and Portland cement and cement mortars for tensile, crushing, and transverse strength, adhesion, soundness, fineness, setting, freezing, and the effect of chemicals. The course also covers tbe mixing of cement into mortar and concrete.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses III., IV. and V.

Texts: *Seminary assignments to various works.*

Three hours per week during the first semester of the Senior year, in connection with Course X. (Hazard.)

IX. HYDRAULICS.

The course deals with the theory and practical application of the properties of fluids at rest and in motion, embracing hydrostatic pressure, manometers, strength of pipes, pressures in tanks and against walls and dams; immersion and flotation; steady flow of liquids through pipes and orifices and over weirs; fluid friction and losses of head; time of emptying vessels; steady flow of water in open channels and Kutter's formula; impulse and resistance of fluids; pumps and rams; the Pelton water motor; overshot, breast and undershot water-wheels; back water; theorem for flow in a revolving pipe; turbine and reaction wheels; theory of turbine testing.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses III., IV. and V.

Texts: Church, *Mechanics of Engineering.*
Church, *Hydraulic Motors.*

Two hours per week during the first semester of the Senior year. (Allison.)

X. HYDRAULIC LABORATORY.

Measurements are made of the flow over weirs, through orifices, and through flumes and ditches. The determination of the approximate law of flow in pipes also forms part of the course. Water-wheels are tested and the efficiency of the hydraulic ram under various conditions is determined.

Arrangements have been made by which this department has the use of the city water supply for experimental work with wheels, and nozzles. This will make available a head of about twelve hundred feet. With the supply available for a few hours' work, tests may be made on wheels developing over three hundred horse-power.

Prerequisite: This course can be taken only in conjunction with Course IX.

Three hours per week throughout the first semester of the Senior year, in connection with Course VIII. (Hazard.)

XI. CONTRACTS AND SPECIFICATIONS.

This course is given to familiarize the student with the forms and the legality of contracts, together with the parties having power to make them and to carry them out. The student also becomes acquainted with the common forms of specifications. Lectures by members of the legal and technical professions assist the student in more fully understanding the subject.

This course is intended only for regular Seniors but others may take it by special permission.

Text: Johnson, *Engineering Contracts and Specifications.*

Two hours per week during the second semester of the Senior year. (Allison.)

XII. ADVANCED MINE AND MILL DESIGN. (Optional.)

This course consists of the design and preparation of detail plans of modern types of mine and mill structures. Special attention is given to the use of steel and reinforced concrete.

Open only to postgraduates.

Six hours drawing per week during the first semester. (Allison.)

XIII. ADVANCED HYDRAULIC DESIGN. (Optional.)

This course consists of the study of water power development, water supply, and the storage and purification of water, including the design of flumes, conduits, simple and reinforced dams, movable dams, tanks, reservoirs, and filters.

Open only to postgraduates.

Six hours drawing per week during the second semester. (Allison.)

MECHANICAL ENGINEERING.

Professor Frank Howard Cronin.
Assistant Professor Robert B. Otis.
Assistant Professor Edwin Cressy Briggs.

I. DESCRIPTIVE GEOMETRY.

This course includes problems relating to the point, line, plane, surfaces, intersections, and developments of surfaces, and numerous practical applications to mine surveying and machine design.

Prerequisites: Entrance requirements.

Text: Church, *Descriptive Geometry.*

Two hours per week during the first semester of the Freshman year. (Briggs, Burger, Sherwood.)

II. DESCRIPTIVE GEOMETRY DRAWING.

A short time at the beginning of this course is given to lettering and geometrical constructions; then follows a direct application of the problems that are taken up in the lecture room.

Prerequisites: Entrance requirements.

Text: Church, *Descriptive Geometry.*
Briggs, *Syllabus and problem pamphlet.*

Six hours per week during the first semester of the Freshman year. (Briggs, Otis.)

III. ELEMENTARY MACHINE DESIGN.

Besides the study of machine elements, special stress is placed upon problems involving the strength and nature of the materials used in machine construction.

Prerequisites: Courses I. and II.

Text: Reid, *Mechanical Drawing and Elementary Machine Design.*

Two hours per week during the second semester of the Freshman year. (Cronin, Otis, Briggs.)

IV. ENGINEERING DRAWING.

The object of this course is to give the students a working knowledge of machine drawing, dimensioning, lettering and tracing, according to modern drafting and shop practice. The plates cover the following: anchor bolts, shaft couplings, hangers, riveted joints, pipe joints, steam and water valves, and engine details.

Prerequisites: Courses I. and II.

Text: Reid, *Mechanical Drawing and Elementary Machine Design.*

Nine hours per week during the second semester of the Freshman year. (Briggs, Cronin, Otis.)

MINING ENGINEERING COURSES.

V. MACHINE DESIGN AND DRAWING.

This is a lecture course covering the fundamental principles of machine design and the practical application of these principles to such problems as are likely to arise in practice. Special attention is paid to problems involving the transmission of power and the best solution of such problems from the standpoint of the mining engineer.

The work in the drafting room is taken up from a thoroughly practical standpoint in order to familiarize the student with the most approved methods of manufacture. Designs and complete working drawings are made of machine parts, shafting layouts, and the various systems and devices used for the transmission of power.

Prerequisites: Completed work of the Freshman year.

This course must be taken in conjunction with or subsequent to Civil Engineering, Course III.

Text: Low and Bevis, *A Manual of Machine Design and Drawing.*

Two hours lectures and six hours drawing per week during the first semester of the Junior year. (Otis.)

VI. STEAM ENGINES AND BOILERS.

The lectures in this course are especially prepared to meet the wants of the mining engineer. They begin with a brief historical treatment of the steam engine. The theory and underlying principles are then taken up and thoroughly discussed. A careful study is then made of the progress and development attained in the art up to the modern high speed engines. The latter part of the course is given up to the subject of boilers, which are treated in much the same manner as steam engines.

The drafting room work takes up the design of hoists, conveying systems, and mill installations. Standard apparatus selected from trade catalogues is used wherever possible. Return tubular boilers and settings, self-supporting and guyed steel stacks, are designed and detailed.

Prerequisite: Course V.

Text: Hutton, *Mechanical Engineering of Power Plants.*
Trade Catalogues.

Two hours lectures and six hours drafting per week during the second semester of the Junior year. (Otis.)

VII. POWER PLANT DESIGN.

This course begins with a study of the problems affecting the location of power plants, and continues with a study of the most approved methods of letting contracts and selecting all kinds of power plant machinery. The first cost, operating cost, and depreciation are carefully considered. The work also includes a study of the best arrangement of the power plant units and auxiliaries and their housing.

The work in the drafting room consists of complete designs for certain parts of the power plant, such as steam piping systems, foundations for boilers and large units, systems of handling coal and ashes.

Prerequisites: Completed work of the Freshman and Sophomore years.
Course VI.

Text: Meyer, *Steam Power Plants.*
Trade Catalogues.

Two hours lectures and six hours drawing per week during the first semester of the Senior year. (Cronin, Briggs.)

VIII. MINE PLANT DESIGN.

This work is a continuation of the course in power plants, which is extended to cover the design for a mine power plant. Each student is assigned a problem that includes a design of a power plant for a certain size mine. The work on the part of the student comprises complete calculations to determine the number and size of units to suit the conditions imposed, the selection of machinery, and the layout of the plant.

Blue prints of all the machinery necessary for a complete plant are kept on hand to facilitate the work. Sufficient detailed and assembled drawings are executed to insure the ready installation of the plant.

Prerequisite: Course VII.

Text: Meyer, *Steam Power Plants.*
Trade Catalogues, and Blue Prints.

Two hours lectures and six hours drawing per week during second semester of the Senior year. (Cronin, Briggs.)

IX. COMPRESSED AIR MACHINERY.

This course includes a study of the theory and practice of air compression. The work comprises a study of the following principal items: single and multiple stage compression; absorption of heat generated during compression; transmission of power by compressed air; freezing of pipe lines; reheating and use of compressed air in engines and pumps. Each student is furnished a catalogue of two or more of the leading compressor builders and a systematic study of these catalogues is taken up in the classroom.

Prerequisites: Either Course VI. or X.

Text: Peele, *Compressed Air Plant for Mines.*
Trade Catalogues.

Two hours per week during the first semester of the Senior year. (Cronin.)

X. GAS ENGINES.

This course is intended to give the mining engineer a practical working knowledge of the gas engine. The theory and thermodynamics of the gas engine are carefully considered, including the conditions affecting efficiency and operation. The best types of modern engines together with auxiliary apparatus are taken up and discussed with regard to special features and advantages. Each student is assigned a seminar paper upon some special subject of investigation. At the conclusion of the course these papers are presented before the class. The last two weeks of the course are devoted to practice in operating and running the engines found in the laboratories.

Prerequisites: Completed work of the Freshman and Sophomore years.
Either Course VI. or X.

Text: *Trade Catalogues and Pamphlets.*

Two hours per week during the first semester of the Senior year. (Otis.)

XI. PUMPING MACHINERY.

This course comprises a careful study of the principle, design, and operation of all kinds of pumping machinery. Special attention is paid to the selection and installation of steam, electric, and compressed air pumps for mine service. Problems involving the calculation of capacity, slip, and duty of pumping engines are assigned to the students. Along with the study of pumping machinery considerable time is devoted to the study of air-lifts.

Prerequisites: Completed work of the Freshman and Sophomore years.
Either Course VI. or X.

Text: *Trade Catalogues and Notes.*

Lectures two hours per week during the second semester of the Senior year. (Cronin.)

XII. MECHANICAL ENGINEERING LABORATORY.

In this course each student performs careful tests in the laboratory along the following principal lines: use of the steam and gas engine indicator; valve setting; use of the separating and throttling calorimeters; efficiency test of steam and gas engines; efficiency and capacity tests of boilers, of air compressors and of steam turbines. From the data on the foregoing tests the student makes complete calculations and submits a complete report on each experiment.

Prerequisites: Completed work of the Freshman and Sophomore years.
Either Course VI. or X.

Reference: Carpenter, *Experimental Engineering.*

Three hours per week during the first semester of the Senior year. (Cronin, Briggs.)

METALLURGICAL ENGINEERING COURSES.

XIII. MACHINE DESIGN AND DRAWING.

This course is highly specialized along the line of metallurgical engineering appliances. The lecture and drawing work includes the theory and practice of belting, manila and wire rope drives, hoists, bucket and belt conveyors, toothed and friction gearing, cams, shafting, and blowers.

Prerequisites: Completed work of the Freshman year.

This course must be taken in conjunction with or subsequent to Civil Engineering, Course III.

Text: Low and Bevis, *A Manual of Machine Drawing and Design.*

One hour lecture and three hours drawing per week during the first semester of the Junior year. (Briggs.)

XIV. STEAM ENGINES AND BOILERS.

The work of this course is especially designed to meet the needs of the metallurgical students, although the problems are of the same nature as those given to the mining students.

The work in the drafting room is a continuation of Course IX. covering the design of stacks, furnaces, flues, and piping.

Prerequisites: Course IX.

Text: Hutton, *Mechanical Engineering of Power Plants.*

One hour lecture and three hours drawing per week during the second semester of the Junior year. (Briggs.)

XV. POWER PLANT DESIGN.

This course begins with a study of the problems affecting the location of power plants and continues with a study of the most approved methods of letting contracts and selecting all kinds of power plant machinery. The items of first cost, operating cost, and depreciation are carefully considered. The work also includes a study of the best arrangement of the power plant units and auxiliaries and their housing.

The work in the drafting room consists of laying out to scale foundations for machinery, return tubular boilers, steam piping systems, coal and ash handling systems.

Prerequisites: Completed work of the Freshman and Sophomore years.
Course X.

Text: Meyer, *Steam Power Plants.*
Trade Catalogues.

One hour lecture and three hours drawing per week during the first semester of the Senior year. (Otis.)

XVI. METALLURGICAL PLANT DESIGN.

This work is a continuation of the work on power plants which is extended to cover the design of a power plant for a concentrating, a cyanide, or a chlorination mill. The work on the part of the student comprises complete calculations to determine the number and size of units to suit the conditions imposed, the selection of machinery, and the layout of the plant. The student has access to many blue prints from manufacturing concerns to facilitate his work. Sufficient detailed and assembled drawings are executed to insure the installation of the plant.

Prerequisite: Course XI.

Text: Meyer, *Steam Power Plants.*
Trade Catalogues and blue prints.

One hour lecture and three hours drawing per week during the second semester of the Senior year. (Otis, Traphagen, Haldane.)

POSTGRADUATE COURSES.

XVII. MINE PLANT TESTING.

This course is arranged with the idea of giving the student an opportunity to secure data by engineering methods from actually operating plants. The plants from which data is secured may be those of either coal or precious metal mines, or both. The tests may be conducted upon any one department of the plant or upon the plant as a whole. The work consists for the most part of determining the power used, by various makes of machinery for hoisting, pumping, air compression, generating electric light and power, conveying, ventilating, and for general shop purposes.

The student takes the necessary apparatus in the field, sets it up in place and conducts the test in such a manner and for such a length of time as is necessary to obtain consistent engineering data. In order to carry on the work successfully, the student must be thoroughly familiar with the methods and apparatus used in conducting tests on power plants. The methods used may be summed up briefly as follows: sampling and analyzing coals and gases; sampling and determining quality of steam; indicating reciprocating units: brake horsepower tests; valve setting and metering steam, air, and electrical energy.

The proximity of the college to plants of mining and metallurgical operations affords special opportunities and facilities for carrying on this work.

The equivalent of one hour lecture and three hours laboratory during the second year of the postgraduate course in Mining Engineering. (Cronin, Otis, Briggs.)

XVIII. GAS ENGINE DESIGN. (Optional.)

In this course the student is assigned the problem of designing an engine, of either the two or four cycle type, capable of developing a specified horse power when working under certain conditions, depending upon the service, locality, and kind of fuel. The theory and underlying principles of gas engine design are carefully considered and practically applied according to the most approved business methods of manufacture.- With the final completion of the general design, a set of detail working drawings is made, conforming rigidly to the requirements of the modern shop where cost systems and part lists are in vogue. Open only to postgraduates.

Six hours drawing per .week during the first semester. (Otis.)

XIX. KINEMATICAL DRAWING OF MINING MACHINERY. (Optional.)

The purpose of this course is to give the student a thorough understanding of the advanced kinematical problems that occur in the design of mining and metallurgical machinery. Besides the study of existing machinery, original designs involving kinematical principles are taken up. It is presupposed that the student taking this course has a thorough understanding of the elementary principles of kinematics. Open only to postgraduates.

Six hours drawing per week during the second semester. (Briggs.)

XX. COAL TESTING. (Optional.)

It is the purpose of this course to determine the adaptability and calorific value of the various kinds of coal found in this section of the country for power plant purposes by actually burning them under a boiler. The complete and ample equipment at the college affords a special opportunity for carrying on such work. Open only to postgraduates. (Cronin.)

ELECTRICAL ENGINEERING.

Assistant Professor William Jonathan Hazard.

I. ELECTRIC POWER TRANSMISSION.

The object of this course is to familiarize the student with the practical applications of electricity and to enable him to make intelligent selection of apparatus found in the market which will best fulfil his requirements. It deals with the generation, measurement, transmission, and utilization of direct currents. The various systems of lighting are discussed. Direct current motors with their auxiliaries are studied in some detail to enable the user to adapt machines to altered conditions of use, where such changes are possible. Many problems are given to fix in the mind the principles studied. The course is given by text-book and lectures, supplemented by laboratory work and visits to various power plants.

Prerequisites: Completed work of the Freshman year.
Physics I. to IV. inclusive.

Text: Franklin and Esty, *Elements of Electrical Engineering. Direct Currents.*

Two hours per week during the first semester of the Junior year. (Hazard.)

II. ELECTRIC POWER TRANSMISSION.

The work in the second semester in this subject is carried on in essentially the same manner as in the first semester, dealing with the generation, measurement, transmission, and utilization of alternating currents.

Prerequisite: Electrical Engineering I.

Text: Franklin and Esty, *Elements of Electrical Engineering. Alternating Currents.*

Two hours per week during the second semester of the Junior year. (Hazard.)

III. ELECTRICAL LABORATORY.

This is the laboratory course accompanying Courses I. and II. It includes the calibration of voltmeters, ammeters and wattmeters; the measurement of the resistances of generators and motors; the determination of the range and capacity of rheostats for voltage and speed control; finding the saturation and characteristic curves and efficiencies of machines; determining the regulation and power factor of motors; the character of speed control by different systems; acceleration curves; starting current and starting torque of induction motors; practice in synchronizing machines and testing insulators.

Prerequisites: Completed work of the Freshman year.
Physics I. to IV. inclusive.

Three hours per week during the first semester of the Junior year for the Metallurgical Engineering course and three hours per week during the second semester of the Junior year for the Mining Engineering course. Also, six hours per week for the class during the Senior trip. (Hazard.)

IV. ELECTRICITY APPLIED TO MINING.

This course is designed as an extension of Courses I. and II., but since it is planned for postgraduates only, it is made as flexible as possible to suit the needs of the individual student. The course is given by text-book and lectures supplemented by assigned reading in the technical press.

Prerequisites: Physics I. to IV.

Text: Hutchinson and Ihlseng, *Electricity in Mining.*

Two hours per week throughout the first year of the postgraduate course. (Hazard.)

V. ELECTRICAL LABORATORY.

This course accompanies Course IV. and is intended to give the student practical experience in handling electrical apparatus in general and to make him familiar with the characteristics of the motors and auxiliaries which he will need in the mine and mill.

Prerequisite: This course must be taken in conjunction with Course IV.

Three hours per week throughout the first year of the postgraduate course. (Hazard.)

CHEMISTRY.

PROFESSOR HERMAN FLECK.
ASSISTANT PROFESSOR CHARLES DARWIN TEST.
ASSISTANT PROFESSOR JOHN CHRISTIAN BAILAR.
INSTRUCTOR WILLIAM SAMUEL MEDELL.
ASSISTANT ALFRED E. PERKINS

The courses in chemistry are arranged especially for the needs of the mining and metallurgical engineer. The demands made upon chemistry by these branches of engineering require a broad knowledge of inorganic chemistry, of the theories underlying the science, and a close acquaintance with the properties of the elements, their reactions, detection, and separation.

I. GENERAL CHEMISTRY.

The course begins with a historical sketch of the development of the science of chemistry up to the atomic era. Thereafter history is introduced only as occasion demands. While the course rests on a structure of inorganic chemistry, the development and application of modern theories and of organic chemistry are taught as the work advances through the non-metallic elements during the first semester. Simultaneously a closer inspection of these elements is offered in the laboratory.

Prerequisites: Entrance requirements.

Text: Richter, *Inorganic Chemistry.*

Four hours lectures, one hour recitation, per week during the first semester of the Freshman year.

(Fleck, Test, Bailar, Medell.)

II. GENERAL CHEMISTRY.

The second semester proceeds with the metals, which follow in the order of their periodicity, in accordance with the periodic law. Elementary metallurgy is introduced as the commercially important metals are considered.

Prerequisites: Entrance requirements.

Text: Richter, *Inorganic Chemistry.*

Four hours lectures, one hour recitation, per week during the second semester of the Freshman year.

(Fleck, Test, Bailar, Medell.)

III. QUALITATIVE ANALYSIS. *Lectures.*

The course treats of the theory of qualitative analysis and of special methods of identification. The law of Mass Action and the Dissociation Theory are drawn upon for the former, and standard works and current literature supply the latter.

Prerequisites: Entrance requirements.

Texts: Prescott and Johnson, *Qualitative Analysis.*
School of Mines, *Qualitative Notes.*

One hour per week during the first semester of the Freshman year. (Fleck, Test, Bailar, Medell.)

IV. QUALITATIVE ANALYSIS. *Laboratory.*

The course begins with a short review of the non-metals in the laboratory. The student, equipped with a working knowledge of experimental manipulation, undertakes the study of the reactions of the bases and their separation.

Prerequisites: Entrance requirements.

Texts: Prescott and Johnson, *Qualitative Analysis.*
School of Mines, *Qualitative Notes.*

Nine hours per week during the first semester of the Freshman year. (Fleck, Test, Bailar, Medell, Perkins.)

V. QUALITATIVE ANALYSIS. *Lectures.*

The course proceeds with the study of the metals, their detection and separation by special methods, and dwells particularly upon correct interpretation of the reactions involved and precautions necessary to obtain correct results. Details concerning the treatment of compounds, including minerals and mixtures, are entered into.

Prerequisites: Entrance requirements.

Text: Prescott and Johnson, *Qualitative Analysis.*
School of Mines, *Qualitative Notes.*

One hour per week during the second semester of the Freshman year. (Fleck, Test, Bailar, Medell.)

VI. QUALITATIVE ANALYSIS. *Laboratory.*

The practice of manipulation and study of the bases, their detection and separation are continued. The acids are then taken up and treated after the manner of the preceding. More complex substances are given for analysis. The decomposition, solution, and examination of refractory substances follow.

Prerequisites: Entrance requirements.

Text: Prescott and Johnson, *Qualitative Analysis.*
School of Mines, *Qualitative Notes.*

Six hours per week during the second semester of the Freshman year. (Fleck, Test, Bailar, Medell, Perkins.)

VII. QUANTITATIVE ANALYSIS. *Lectures.*

(GRAVIMETRIC.)

The work of the first semester begins with a consideration of the theories of solution, electrolytic dissociation, and mass action as applied to analytical chemistry. The determination and separation of the elements and important radicals are considered in detail. The aim of the course is to study the general principles and methods of separation as used in quantitative analysis.

Prerequisites: Courses I. to VI. inclusive.

Text: Cairns, *Quantitative Analysis.*

One hour per week during the first semester of the Sophomore year. (Test.)

VIII. QUANTITATIVE ANALYSIS. *Laboratory.*

(GRAVIMETRIC.)

The work begins with the analysis of simple salts. By this means the practice of manipulation and the observance of necessary precautions are learned. Gradually the analyses of substances of more complex nature are introduced.

Prerequisites: Courses I. to VI. inclusive.

Text: Cairns, *Quantitative Analysis.*

Nine hours per week during the first semester of the Sophomore year. (Fleck, Test, Bailar, Medell, Perkins.)

IX. QUANTITATIVE ANALYSIS. *Lectures.*

(VOLUMETRIC.)

This course consists of a study of volumetric methods of analysis. First, the theory of indicators and methods of acidimetry and alkalimetry are taken up. Later, the methods of the determination of the more important substances are studied. Special attention is given to the principles of the methods used in smelter practice.

Prerequisites: Courses I. to VI. inclusive.

Texts: Bailar, *Laboratory Notes.*
Cairns, *Quantitative Analysis.*

One hour per week during the second semester of the Sophomore year. (Test.)

X. QUANTITATIVE ANALYSIS. *Laboratory.*

(VOLUMETRIC.)

This course covers the use of standard solutions and a study of the reactions involved. In due time the methods commonly used in metallurgical industries are introduced. A knowledge of the preparation of standard solutions and their use is acquired by a course in acidimetry and alkalimetry. The preparation of standard solutions and their use in the wet assays or ores and products containing iron, manganese, lead, zinc, copper, and other metals are practised.

Prerequisites: Courses I. to VI. inclusive.

Text: Bailar, *Laboratory Notes.*

Nine hours per week during the second semester of the Sophomore year. (Fleck, Test, Bailar, Medell, Perkins.)

XI. INDUSTRIAL CHEMISTRY.

A broader acquaintance with industrial methods of chemistry, especially in the inorganic field, is an essential in the education of the engineer. The course is intended to supply this by illustrated lectures on chemistry applied to the arts and the apparatus used therein. Among the subjects considered are: explosives, sulphur and its compounds, potassium nitrate, ammonia, chlorine and its compounds, bromine, iodine, acids, alkalis, potassium cyanide, bricks and other clay products.

Prerequisites: Courses I. to VI. inclusive.

Two hours per week during the first semester of the Sophomore year. (Bailar.)

XII. INDUSTRIAL CHEMISTRY.

The second semester continues with the following subjects: petroleum and its products, mineral paints, cements, fuels and refractory materials.

Prerequisites: Courses I. to VI. inclusive.

Two hours per week during the second semester of the Sophomore year. (Bailar.)

XIII. METALLURGICAL CHEMISTRY.

This course, essentially a laboratory course, embraces work requiring skill, accuracy, and experience acquired in the preliminary courses. The student performs operations which bring him into touch with the products of less common metallurgical processes, and also acquires a good idea of the chemical practice used in conjunction with common metallurgical operations which he himself performs or observes. Naturally this adds to the knowledge, speed, and accuracy expected of him in actual practice. Among the tasks imposed are the estimation of bismuth, nickel, cobalt, cadmium, the examination of electrolytic slimes, the application of previously acquired knowledge in checking actual metallurgical operations and the study of the more useful rare metals and their estimation.

Prerequisites: Completed work of the Freshman year.
Courses VII. to X. inclusive.

Seven hours per week during the first semester of the Junior year. (Fleck.)

XIV. CEMENTS AND CLAYS. (Optional.)

This course is intended to give the student a working knowledge of the subject, and is studied, not alone in the laboratory and classroom, but to a fuller extent in the field and factory. Among the subjects considered are the following: cement material; examination and sampling of deposits; economics of quarrying or mining cement material; economics of location of plant; calculation, preparation, and burning of cement mixtures; effect of different substances on cement; cement analysis; brick making (a) from shale, (b) from plastic clay; brick material; correcting imperfections in clays; principles which govern the treatment of clays for all purposes, including fire clays and other refractory materials.

Only open to postgraduates.

Six hours laboratory per week during the second semester.
(Bailar.)

XV. CHEMISTRY OF THE RARE METALS. (Optional.)

This course embraces the analytical methods, qualitative and quantitative, used in the detection and estimation of the useful rare metals or of those concerned in the practices relating to other metals. The metals concerned are lithium, titanium, zirconium, thorium, thallium, vanadium, tantalum, molybdenum, tungsten, uranium, selenium, tellurium, and the platinum group. The ores of these metals are considered with special reference to their rare metal presence and contents, and, where possible, the principles underlying their extraction are studied.

Open only to postgraduates.

Six hours laboratory per week during the second semester.
(Fleck.)

XVI. ELECTROCHEMICAL ANALYSIS. (Optional.)

The aim of this course is to give the student a practical knowledge of electro-chemical methods of analysis and the more common chemical reactions which take place under the influence of the electric current. That this object may be obtained, the course includes the estimation, by electrochemical means, of about fifteen of the more common metals and afterwards a separation of these metals. The principles learned are then applied to the analysis of minerals and smelting products. Later experiments are taken up illustrating the principles of oxidation and reduction, and a number of substances, the formation of which depends upon these principles, are prepared.

Open only to postgraduates.

Six hours laboratory per week during the second semester.
(Test.)

XVII. RARE METALS.

The remarkable rise in technical importance of the so-called rare elements has called many of them from obscurity to serve the wants of daily life. It becomes necessary to call attention to the practical possibilities of these elements by a study of their occurrence, extraction, and chemistry. The course offers a series of lectures on these subjects for all the rare elements now in demand for their practical value.

Two hours per week during the second semester of the second year of the postgraduate Metallurgical Engineering course.

(Fleck.)

PHYSICS.

ASSISTANT PROFESSOR LOUALLEN FREDERICK MILLER.
ASSISTANT FRANK M. ROBBINS.

In arranging the courses of this department the aim has been to make them as practical as possible, emphasizing those phenomena that bear directly on engineering problems, and yet not neglecting those facts which, though not so important of themselves, still are highly valuable in showing the close relationship that exists between physical laws. Special attention is given to problems involving the use of these laws, to actual demonstrations of their validity, and, as far as possible, to laboratory work verifying them quantitatively.

I. GENERAL PHYSICS.

This course consists of lectures, illustrated by experiment, and recitations with assigned problems. The subjects treated are as follows: mechanics, including the elements of kinematics, dynamics and hydrostatics; the properties of matter; sound, including wave motion in general, production and propagation of sound waves, pitch, reflection, refraction, interference and resonance; light, including propagation, reflection, refraction, dispersion, interference, emission, absorption, and polarization.

Prerequisites: Mathematics, Courses I. to IV. inclusive.

Text: Carhart, *University Physics.*

This course must be preceded by or taken in conjunction with Mathematics V.

Three lectures and one recitation per week during the first semester of the Sophomore year. (Miller.)

II. GENERAL PHYSICS.

This course is a continuation of Course I. The subjects treated are as follows: heat, including thermometry and expansion, calorimetry, change of state, conduction, radiation and the elements of thermodynamics; electricity and magnetism, including electro-statics, electro-kinematics, thermo-electricity, magnetic induction, electromagnetism, electrolysis, the electro-magnetic theory, and electric oscillations.

Prerequisite: Course I.

Text: Carhart, *University Physics.*

Three lectures and one recitation per week during the second semester of the Sophomore year. (Miller.)

III. PHYSICAL LABORATORY.

This course is arranged to accompany Course I. Its aim is to teach the student the necessity of careful work as well as to acquire skill in physical measurements so that the important physical laws can be quantitatively verified.

Prerequisites: Mathematics, I. to IV. inclusive.
Physics I. must be taken in conjunction with this course.

Text: Reed and Guthe, *A Manual of Physical Experiments.*

Three hours per week during the first semester of the Sophomore year. (Miller, Robbins.)

IV. PHYSICAL LABORATORY.

This course is a continuation of Course III.

Prerequisite: Course III.

Physics II. must be taken in connection with this course.

Text: Reed and Guthe, *A Manual of Physical Experiments.*

Three hours per week throughout the second semester of the Sophomore year. (Miller, Robbins.)

V. RADIO-ACTIVITY AND SPECTROSCOPY. (Optional.)

In radio-activity, a study is made of radio-active substances and the theory of the phenomena. Experiments are given in the measurement of radio-activity and its detection in ores.

In spectroscopy, a study is made of the theory and use of the spectroscope, after which the measurement and determination of the spectra of the various metals is made, applying the spectroscope to the detection of rare metals in ores.

Open only to postgraduates.

Six hours laboratory per week during the second semester. (Miller.)

MATHEMATICS.

Professor Charles Roland Burger.
Instructor George Eulas Foster Sherwood.

The courses in this department have been arranged to meet the extensive needs of students in the various branches of engineering. The subjects are treated so as to give the student both logical training and power of application. The principles which are of greatest value in engineering work are particularly emphasized. The courses offered serve as a sufficient prerequisite for the work in mathematical physics, physical chemistry, engineering and applied mechanics; and they mark the minimum of mathematical attainments that an engineer ought to possess. A special feature of the work is the early introduction of the calculus, the principles of which are introduced with those of analytic geometry and developed as needed, thus disregarding, to a certain extent, the traditional barrier that has existed between these subjects. By this means, the principles of the calculus are allowed to develop slowly, their sphere of usefulness is widened, the student gains a better grasp of mathematics as a whole, and is able, early in his course, to make direct application of his knowledge of mathematics to practical problems.

I. COLLEGE ALGEBRA.

This course begins with a comprehensive treatment of quadratics. The fundamental operations are constantly kept in mind and the student is drilled in the reduction of actual problems that come up later in his course. Graphic representation of equations is early introduced in the belief that the illumination which it affords greatly enlivens the entire presentation of the subject and brings algebra into closer relationship with the other mathematical courses. The progressions, inequalities, proportion, and variation, convergency and divergency of series, undetermined coefficients with applications to partial fractions and expansion of functions in series, the binominal theorem, logarithms, exponentials, permutations and combinations, continued fractions, determinants and those propositions of the theory of equations that lead to the determination of the roots of numerical equations, are all amply treated.

Prerequisites: Entrance requirements.

Text: Hawkes, *Advanced Algebra.*

Five hours per week during the first semester of the Freshman year. (Burger, A. C. Smith, Sherwood.)

II. TRIGONOMETRY.

The general formulæ of plane and spherical trigonometry are developed. Much practice is given in the use of tables and the applications of trigonometry to mensuration in general. The astronomical triangle and such problems relating thereto as come up in surveying are dwelt upon particularly and graphic representation is given its needed emphasis.

Prerequisites: Entrance requirements.

Texts: Crawley, *Elements of Trigonometry.*
Hodgman, *Surveyor's Tables.*

Three hours per week during the first semester of the Freshman year. (Burger, Briggs, Sherwood.)

III. ELEMENTS OF ANALYSIS.

This course aims to present in a logical manner certain material generally given in distinct courses under the names of Advanced Algebra, Analytic Geometry, and the Elements of Calculus.

The language, the symbols and the first processes of infinitesimal calculus, both in the pure and applied form, are explained. Many illustrations in geometry, physics, engineering, and applied mechanics are introduced. The fundamental principles of continuity, limiting values, theory of infinitesimals, and the differentiation and integration of the elementary forms are established. Application is made to problems involving maxima and minima, rates, and to theorems in analytic geometry. Many problems are assigned to acquaint the student with the fundamental operations of the calculus.

Prerequisites: Courses I. and II.

Text: Woods and Bailey, *A Course in Mathematics.*

Three hours per week during the second semester of the Freshman year. (Burger, Briggs, Sherwood.)

IV. ANALYTIC GEOMETRY.

The analytic geometry of the straight line, circle and conic sections, including a discussion of the general equation of the second degree, is amply treated. Methods of the calculus are introduced. In the solid analytic geometry, besides the plane and the straight line, the cylinders and the surfaces of revolution are treated, and all the quadric surfaces are studied from the simplest forms of their equations.

Prerequisites: Courses I. and II.

Text: Woods and Bailey, *A Course in Mathematics.*

Five hours per week during the second semester of the Freshman year. (Burger, A. C. Smith, Sherwood.)

V. DIFFERENTIAL AND INTEGRAL CALCULUS.

This course is a continuation of Course III. in which students are made familiar with the ordinary processes and applications of the calculus. A principal feature of this subject consists of carrying on the development of the differential and of the integral calculus together. This method of instruction enables the student to grasp the more difficult notions of the subject in their inherent relations, and at the same time to apply this knowledge, early in the course, to the solution of engineering problems.

Prerequisites: Courses I. to IV. inclusive.

Text: Osborne, *Differential and Integral Calculus.*

Five hours per week during the first semester of the Sophomore year. (Burger, Sherwood.)

VI. INTEGRAL CALCULUS.

This course is a continuation of Course V. The notion of a definite integral is stated in its fundamental and most comprehensive form. The aim is to make clear the *rationale* of each process, and to encourage the student to become independent of formulæ of integration. The theory of single and multiple integration is applied to the principal methods of rectification and quadrature, and to the calculation of the surfaces and volumes of solids of revolution. The student is also given many useful and practical applications of the integral calculus. These include many practical problems in physics, engineering, and applied mechanics. For the sake of students in engineering, who wish to use differential equations and have little time to devote to general theory, the theoretical explanations are made as brief as is consistent with clearness and sound reasoning. Practical applications dealing with geometrical, physical, and mechanical problems are constant sources of discussion.

Prerequisites: Courses I. to V. inclusive.

Text: Osborne, *Differential and Integral Calculus.*

Three hours per week during the second semester of the Sophomore year. (Burger, Sherwood.)

VII. MECHANICS.

This course is an introduction to the Mechanics of Engineering of the Junior year and aims to bridge the chasm between pure and applied mathematics. Prominence is given to those principles and results which the student finds to be a direct application of the mathematics and physics as well as those that are of great importance in giving proper development and understanding for the work of Mechanical Engineering of the Junior year. The course is largely a problem course containing exercises in centers of gravity, centers of pressure, moments of inertia, statics of a material point, of a rigid body, of flexible cords, including the suspension bridge and catenary, rectilinear and curvilinear motion including projectiles.

Prerequisites: Courses I. to V. inclusive.

Text: Church, *Mechanics of Engineering, and Notes.*

Two hours per week during the second semester of the Sophomore year. (Burger, Sherwood.)

VIII. PRACTICAL ASTRONOMY. (Optional.)

This course covers the following subjects: a study of the heavenly bodies; their mutual relations, their motions, forms, dimensions, and physical constitution; the relation of the earth to the heavens; the theory of the determination of time, latitude, longitude and azimuth; attraction of the moon, tides; mass and density of the earth; problems of gravitation; astronomical instruments and their mathematical theory.

Open only to postgraduates.

Lectures two hours per week during the first semester.

(Burger.)

IX. PRECISE SURVEYING AND GEODESY. (Optional.)

This course covers the following subjects: an introduction to the method of least squares; precise plane triangulation; base lines, standard tapes, corrections for temperature, sag, and pull; precise leveling; L. M. Z. determinations; spherical and spheroidal geodesy; plumb line deflections; terrestrial magnetism; convergence of meridians; running parallel arcs; geodetic co-ordinates and map projections; reconnaisance; adjustments of triangles and quadrilaterals; the earth as a spheroid, ellipsoid, ovaloid, geoid; construction and use of tables.

Open only to postgraduates.

Lectures two hours per week during the second semester.

(Burger.)

ENGLISH.

PRESIDENT VICTOR CLIFTON ALDERSON.

The purpose of this course is to train the members of the Senior class to use clear, accurate, and simple English. Weekly themes are required which are carefully corrected and returned.

Prerequisite: This course is intended only for the regular members of the Senior class.

One hour per week throughout the Senior year. (Alderson.)

INSPECTION TRIPS.

The same importance is attached to the inspection trips as to class room and laboratory work. Grades are given on reports submitted and satisfactory results are required for graduation.

MINING TRIPS.

Throughout the course the classes make trips to mines and witness the varying practices and operations of mining and see the machinery and plants described in the class rooms. These trips are planned and graded in such an order that different but definite interesting features are introduced in the successive visits to the various mining districts of the State. Lectures precede these trips to explain their objects, the properties to be visited, the operations to be viewed, and the mechanical equipments to be investigated. Each student is encouraged to develop his power of observation and is required to submit a concise report after each trip.

Advanced standing students or postgraduates are required to take all of the mining trips as they occur.

During the first semester of the Sophomore year, a trip is made to Gilpin County. In the second semester of this year, the class is taken to a coal mine in the Northern Colorado field.

The Juniors are taken during the first semester to Cripple Creek.

Upon each of these expeditions, the surface and underground equipments of mines are carefully noted. The facts thus acquired by each student furnish practical examples for the study of mine plants which is given as a required course during the Senior year. Printed outlines of objects to be noted during the inspection of a district or mine are furnished each student.

METALLURGICAL TRIPS.

Beginning with the Junior year and continuing throughout the Senior year, metallurgical trips are taken to the various mills and smelters in the State, for the purpose of illustrating the lecture courses.

Printed outlines of reports, carrying out all of the important features peculiar to the plant and to the practice are given to the students. A written report on each trip is turned in for correction and criticism.

During the Junior year the following plants are visited:

The Globe plant of the American Smelting and Refining Company at Denver, and the Independent Smelter at Golden, for a study of furnaces of various types and ore sampling.

The Minnequa plant of the Colorado Fuel and Iron Company at Pueblo, for a study of the manufacture of iron and steel and the working up of the product into commercial forms.

The Pueblo and Eiler's plants of the American Smelting and Refining Company, for a study of the metallurgy of lead.

The zinc plant of the American Smelting and Refining Company at Pueblo, and the plants of the Empire Zinc Company, and the United States Smelting Company at Canon City, for a study of the metallurgy of zinc.

During the Senior year the following plants are visited:

The Jackson, Newton, Hudson, and other mills in Idaho Springs, for the study of ore dressing.

The various stamp mills of Black Hawk and Central City, for the study of amalgamation.

The Colorado Zinc Company and the Blake-Morscher works in Denver, for magnetic and electro-static separation.

The Boston and Colorado Company's plant at Argo, for the metallurgy of copper.

The cyanide mills of Idaho Springs, Colorado City, and Cripple Creek for the cyanide process.

The Portland and Standard mills at Colorado City, for the chlorination process.

POWER PLANT INSPECTION TRIPS.

Along with the course in power plant design the Seniors make inspection trips to large power plants in and around Denver. Among the plants visited are the following: The Denver Gas and Electric Co., the Denver Union Water Co., and the Northern Colorado Power Co. at Louisville.

MINING MACHINERY TRIPS.

In order to become familiar with the structural features of the different machines commonly used in mining operations. occasional trips are made to Denver plants that manufacture or deal in mining machinery. Students are frequently permitted to take down and reassemble machinery and thus gain an intimate knowledge of the details not to be acquired in any other way. Among the houses which grant these privileges are the following: The Hendrie & Bolthoff Manufacturing and Supply Company, The Colorado Iron Works Company, The Denver Engineering Works, Fairbanks. Morse & Company, and The J. George Leyner Engineering Company.

INDUSTRIAL CHEMISTRY TRIPS.

In connection with the course in Industrial Chemistry, inspection trips are made to the following: The Western Flint Glass Company, The Denver Sewer Pipe Company, The Denver Stoneware Company, The Western Chemical Manufacturing Company, The Golden Pressed and Fire Brick Company, the plant of the Denver Gas and Electric Company for a general study of artificial fuels and the treatment of by-products, and the brick yards near Golden.

SENIOR TRIP.

At the conclusion of the Senior year an extended trip, lasting about a month, is made to important centers in Colorado, Utah, and Montana for advanced work in geology, metallurgy, mining, and engineering.

Detailed work is assigned to each student. The results of his observations and investigations are carefully written and are criticised by his instructors. Five professors accompany the class and maintain the same high standard of study that is required at Golden. Private sleepers, day coach, and baggage cars are chartered for the trip.

Everywhere the greatest courtesies are extended. Not only are the plants thrown open for inspection but members of the staff are detailed as guides. Many students secure good positions during the trip and form acquaintances that are apt to be of value to them later.

ITINERARY.

COLORADO.

Colorado Springs.

Metallurgy.

Portland Mill; barrel chlorination of telluride ores; tube milling and cyanidation of tailings.

Golden Cycle Mill: roasting and cyanidation of Cripple Creek ores with separate treatment of classified sands and slimes.

Standard Mill: chlorination of gold ores with the use of electrolytic chlorine and cyanidation of previously formed tailings.

Geology.

An excursion to Glen Eyrie, the Garden of the Gods, and Manitou is made for the purpose of studying the Archæan granite and gneiss and the Paleozoic and Mesozoic series of rocks uncomformable thereon and strongly upturned.

Engineering.

Pike's Peak Hydro-electric Plant: three impulse wheels equipped with Lombard governors which deflect the jet into a long tank to absorb the energy of the discharge; needle nozzles, hand operated, are used on wheels; 3-1,000 K. W., 6,600 volt, 3-phase generators; 2 wheel driven exciters; head 2,300 feet; motor operated valves.

Portland Gold Mining Co. Mill: driven by 3-phase motors; synchronous motors for the heaviest continuous load and induction motors for the remainder.

Golden Cycle Mill: electrically operated; motors of all sizes up to 200 H. P.; motor generator set for supplying continuous current for haulage.

PORTLAND.

Metallurgy.

Colorado Portland Cement Company: crushing and fine grinding of raw material and clinker.

CANON CITY.

Metallurgy.

Empire Zinc Company: wet and magnetic separation of zinc ores and magnetic treatment of Wilfley table middlings; experimental plant with magnetizing roaster, magnetic separators, dry and electrostatic separators and Elmore installation.

United States Smelter: pigment smelting of complex zinc-lead ores, and the working of the product into a marketable form.

Engineering.

United States Smelter: steam power plant; Corliss and high speed engines, driving fans and Root blowers; return tubular boilers.

LEADVILLE.

Metallurgy.

Arkansas Valley Plant of the A. S. & R. Co.: lead smelting; Ropp, Brown-Horseshoe, Godfrey and H. & H. roasting; briquetting, and blast furnace treatment of silver-lead ores.

Adams Mill: wet concentration of lead ores.

Yak Mill: magnetic concentration with International separators.

Mining.

The class is taken into the Yak Tunnel and through the several mines connected therewith, being finally hoisted to the surface of Breece Hill through the shaft of the famous Little Jonny mine. The Adams and Wolftone mines are also visited. Excellent opportunity is afforded to study the two distinctive kinds of ore bodies for which this district is noted, and to learn, by observation, how these dissimilar ore bodies are attacked and their contents successfully extracted. Interest attaches to the unusual variety of metals mined, the ores containing gold, silver, and most of the base metallic sulphides.

Engineering.

Arkansas Valley Plant, A. S. & R. Company: steam power plant; capacity 1,500 H. P.; condensing Corliss engines belted to Connersville blowers; return tubular boilers equipped with underfeed stokers.

Central Colorado Power Company: steam power plant; Curtis turbines, direct connected to 3-phase, 6,600 volt, 60 cycle alternators; current stepped up to 50,000 volts for long distance transmission over steel tower line; small and moderate sized units; Alberger surface condensers with independent dry vacuum pump and centrifugal circulating pump; 400 H. P. B. & W. boilers, hand fired.

Yak Tunnel: Silver Cord property; two-drum electric hoist; motor driven compressors; compressed air and electric driven pumps; continuous current haulage.

Geology.

The Paleozoic series and fault systems are studied underground and the sharply defined moraines, and other glacial phenomena on the surface.

ASPEN.

Mining.

Among the rich silver mines which are visited are the Smuggler, Mollie Gibson, Aspen, Durant, and Argentum-Juniata. The many interesting features presented by these properties include the very irregular forms of ore body, the intense heat from smoldering, underground fires, and the combatting of heavy flows of water.

SHOSHONE.

Engineering.

Central Colorado Power Company's Hydro-electric plant; water from the Grand River is conducted through a tunnel cut inside of the mountain for approximately two and one-quarter miles, delivered through penstocks to central discharge turbines under a head of 260 feet; ultimate capacity of plant approximately 25,000 H. P.; ultimate transmission voltage 100,000.

SHOSHONE AND GLENWOOD.

Geology.

Archæan gneisses and schists, and uncomformable above these the Paleozoic rocks exposed in the canyon of the Grand River; typical canyon erosion and travertine deposits. At Glenwood the mesozoic rocks.

UTAH.

BINGHAM.

Mining.

This district permits the study of three distinct systems of mining, namely, the overhead stoping, the caving, and the open pit. The extensive properties and operations of the Utah Consolidated Mining Company, the Utah Copper Mining Company and the Boston Consolidated Mining Company are open to the unrestricted inspection of the class. Further interest in this district comes from the opportunity to study aerial tram systems, difficult railroad engineering, and the operations of single companies under different systems.

Geology.

The Carboniferous quartzite and limestone, with intruded igneous masses that have marmorized at contact with the limestone; the relationship of the ore bodies to these contact phenomena.

BINGHAM JUNCTION.

Metallurgy.

United States Smelting Company: special roasting devices for lead ores, with neutralization and bag-housing of fumes.

GARFIELD.

Metallurgy.

Boston Consolidated Mining Company Mill; stamp milling of Bingham copper ores with Wilfley table and vanner concentration.

Utah Copper Company: roll crushing of Bingham ores with jigging, tabling, and vanning methods of concentration.

Garfield Plant of the A. S. & R. Co.: converter roasting and blast furnace smelting of copper ores; special methods of slag and matte handling.

Engineering.

Utah Copper Company: steam power plant; capacity 10,000 boiler H. P.; 500 H. P. Heine boilers equipped with under-feed stokers; forced draft; concrete stacks; large cross compound Allis and Nordberg engines direct connected to A. C. generators; Wheeler surface condensers with independently driven Edwards air pumps.

American Smelting and Refining Company: steam power plant; large horizontal blowing engines; single stage air compressors driven by cross compound Corliss engines; Worthington surface condensers with Blake air and circulating pump; 500 H. P. Stirling boilers equipped with plain grates.

SALT LAKE CITY.

Metallurgy.

General Engineering Company: special devices for screening, classifying, and concentration of ores.

Geology.

Excursions into the Wasatch Range, showing the great synclinal fold and the Wasatch fault; very recent faults and glacial features; Lake Bonneville terrace formations.

MONTANA.

BUTTE.

Metallurgy.

The Colusa-Parrot Smelting Company: crushing, wet concentration, roasting, and smelting of copper ores; Hancock and Woodbury jigs and special devices of local origin.

The Precipitation Plants: recovery of dissolved copper from mine waters; leaching and recovery of soluble values from dumps.

Mining.

The great mines of this district exhibit modern practices of lode mining in high grade copper ore bodies. The splendid plants, equipments, and methods in use are given detailed attention. Among the noteworthy mining features studied are: deep mining, steel surface structures, automatic loading and dumping of ore, rapid hoisting, mechanical framing of timbers, handling of large volumes of acid water, square set stoping, the driving of working levels in country rock, the naturally high temperatures of the working places, and the systematic recording of every operation. Mine and geological underground surveying are exemplified in the properties of the Amalgamated Copper Company.

Geology.

Secondary enrichment of original sulphide ores; the relationship of these ore bodies to the remarkable fault systems of Butte; the study of granite, aplite, porphyry, and rhyolite rocks.

Engineering.

Amalgamated Copper Company: mine plant at the New Leonard; 3,500 H. P. Nordberg hoist; 150 foot steel head frame; two stage Nordberg air compressors rope driven by induction motors; locomotive type of boilers.

Amalgamated Copper Company: mine plants at the Diamond and Bell mines; very large air compressing plant; two stage compressors equipped for either steam or motor drive; 3,000 H. P. Allis hoisting engine; marine type of boilers; high steel head frame with automatic dumping attachments.

Missouri River Power Company: steam power plant; Westinghouse-Parsons turbines, connected to A. C. generators; surface condensers with independently driven air and circulating pumps; B. & W. boilers equipped with Roney stokers; high tension current station used as relay for the companies' hydro-electric plants and operated in parallel with them.

ANACONDA.

Metallurgy.

The New Reduction Works or Washoe Smelter: track system for the delivery of ores and shipment of products; compressed air traction for yard haulage; concentrating mill of eight one-thousand ton units; bin systems; briquetting plant; largest furnaces in the world; reverberatory furnaces; converter plant; refining furnaces and casting department; arsenic plant, and flue systems. So much is to be seen here that considerably more time is spent in this plant than at any other point, and, owing to the courtesy of the management, much valuable instruction is possible.

The Anaconda Copper Mining Company: brick department; the manufacture of clay and silica brick of the highest degree of refractoriness and of all shapes.

Engineering.

Anaconda New Reduction Works: general power plants; large triple expansion condensing Corliss engines belted to line shaft; two and four stage air compressors driven by cross compound Corliss engines; rotary blowers of the Connersville and Root types, direct connected to Corliss engines; rotary blowers, rope driven from induction motors; Stirling boilers equipped with plain grates; rotary converters and transformers for the high tension current brought in from the hydro-electric plants.

BUILDINGS.

SIMON GUGGENHEIM HALL—Administration Building.

This building, the gift of Senator Simon Guggenheim, of Denver, was erected and furnished at a cost of $80,000. The corner-stone was laid by the A. F. and A. M. of Colorado, October 3, 1905. It is one hundred sixty-four feet long by fifty-seven feet wide and is surmounted by an ornate tower. The first floor is devoted entirely to the Department of Geology and Mineralogy, and includes lecture room, laboratory, office, two work rooms and public museum; the second floor contains the library, the office of the President, Secretary, and Registrar, the Faculty Room and the Trustees' Room; the third floor contains the Assembly Hall, two lecture rooms for Mathematics and two offices. The building was dedicated October 17, 1906.

HALL OF CHEMISTRY.

This is a continuous group of brick buildings, comprising the buildings of 1880, 1882, and 1890. The combined buildings of 1880 and 1882 contain the main chemical laboratories. In the building of 1890 are located the office and laboratory of the professor of Chemistry, the chemical lecture room, the Museum of Applied Chemistry, two recitation rooms, the laboratories for gas and water analysis, and the Freshman drawing room.

ASSAY BUILDING.

This building, a brick structure forty-six by ninety-two feet, was built in 1900 through funds contributed by the late W. S. Stratton, and enlarged in 1905 to allow for the installation of a new equipment of furnaces of the gasoline type. The design and equipment of this building are such as to make it probably the best of its kind in the country.

GYMNASIUM.

This building, costing $65,000, was completed in September, 1908. The first floor contains a room for boxing and wrestling, besides shower baths, locker room, and swimming pool, finished in white marble and tiling.

The second floor contains the offices and a large club room.

The third floor is the gymnasium room proper, fifty-five by one hundred five feet without posts. A gallery accommodates two hundred spectators.

HEATING, LIGHTING, AND POWER HOUSE.

The power plant recently erected at a cost of forty thousand dollars, was designed to furnish light, heat, and power to the entire school. It is a simple but artistic brick building, eighty-three by one hundred and twenty-two feet, with concrete floors and tile roof. The building is divided lengthwise into an engine room thirty-four feet wide, and a boiler room forty-five feet wide. A conduit six feet wide and seven feet high surrounds the engine room below the floor and is used for steam and electric mains. A brick-lined steel stack one hundred twenty-five feet high carries all smoke to the upper air and away from the buildings.

HALL OF PHYSICS.

This building, constructed of red pressed brick, consists of two floors and a basement, and was completed in the fall of 1894. The upper floor contains two physical laboratories, one for electricity and magnetism, and the other for heat and sound, an instrument room and office. The physics lecture and apparatus room, the photometry room, the physical laboratory for mechanics and light, the balance and apparatus room as well as a private office and laboratory occupy the first floor. The basement contains the electrometallurgical laboratory, pyrometry and high temperature laboratory, electro plating room, a magnetic testing laboratory, a laboratory for the study of radio-activity and rare metals by spectroscopic methods, a Junior electrical laboratory, a storage battery room and switch board with connections to all parts of the building.

STRATTON HALL.

The corner-stone of this building was laid by the A. F. and A. M. of Colorado, on November 20, 1902, and was completed in January, 1904. The basement wall and first story are of Lyons sandstone, in broken ashlar, topped by a story of gray Golden brick. The building is finished on the interior with red pressed brick. Little wood is used, except in the floors and staircases. The basement accommodates the metallurgical and ore dressing laboratories. The first floor contains two large lecture rooms, each with apparatus room and private office. The second floor, in one-half, accommodates the surveying and mechanics in one large lecture room, with apparatus room and private office, and in the other half a drafting room. The third floor is devoted entirely to a large drafting room for the Senior class. The structure was named in honor of the late W. S. Stratton, whose gift of twenty-five thousand dollars made the building possible.

RESIDENCE OF THE PRESIDENT.

This is a brick building of two and one-half stories. It was built in 1888.

CARPENTER SHOP.

This is well equipped for the special demands which are continually arising in a technical school. The work varies from ordinary repair work to the careful construction of special apparatus needed in the various departments of the school.

MACHINE SHOP.

What has been said of the carpenter shop is equally true of the machine shop. It is imperative that the school have shops of its own, in order to keep its mechanical apparatus in proper working order, as well as to construct such apparatus as is necessary to carry on any new or original work. The machines of both shops are driven by direct connected motors.

LABORATORIES AND EQUIPMENT.

MINERALOGICAL AND GEOLOGICAL LABORATORY AND CABINET.

Under the name cabinet is embraced not only the distinctively display collections, which may perhaps be called the cabinet proper, but also the other collections that have been prepared mainly for the purpose of class instruction. These collections are necessarily changing rapidly from year to year, as new material is constantly being added. This new material is obtained partly by purchase, but mainly by direct collecting, and by means of exchange with other institutions. The display collections are not classified systematically, but are arranged in different cases with a view to displaying certain groups of minerals or minerals from certain localities.

SUMMARY OF COLLECTIONS.

Type Collection of Minerals	3,700
Working Collection of Minerals (about)	21,000
Display Collection of Minerals	1,305
Supplementary Collection of Minerals	950
Crystal Collection	1,800
Display Collection of Fossils	342
Miscellaneous Collection of Fossils	1,360
Type Collection of Rocks	1,800
Working Collection of Rocks	7,408
United States Geological Survey Educational Series of Rocks	156
Professor Patton's Collection of Rocks	1,700
Professor Patton's Collection of Minerals	970
Summary of specimens	42,491

EXCHANGES.

The college has prepared a printed list of exchange material, covering both minerals and rocks. The list will be sent to all who wish to arrange for exchanges. Correspondents should state what material they are prepared to offer in exchange. Letters should be addressed to Professor H. B. Patton, Golden, Colo.

MINERALOGICAL LABORATORY.

Aside from the special advantages due to location, the Department of Geology is admirably equipped for practical teaching. The entire first floor of Guggenheim Hall is occupied by this department. The south end of the building is occupied by a commodious lecture room, with a seating capacity of over a hundred, and by a separate mineralogical laboratory with table space for between fifty and sixty students, also by two small recitation rooms. On the extreme north end of the building is the public museum, devoted to a display of fine minerals. Additional space is provided for working rooms, offices, packing, and storage rooms.

METALLURGICAL COLLECTIONS.

The college has the advantage of a fine collection of models from the works of Theodore Gersdorf, Freiberg, Saxony, illustrating the best type of furnaces in this and other countries. Each model is made to scale and is complete in every detail. In addition to these models are the following illustrating the best modern practice:

Working model of twenty-stamp mill, on scale of one and one-half inches to the foot.

Working models of crushing rolls, same scale.

Working model of a Dodge crusher.

Model of modern blast furnace for lead-silver ores, with water jacket.

There are also a large number of smaller models, such as the completed set used in the famous Keyes and Arents lead-well suit.

The collection of ores and metallurgical products is constantly being augmented.

METALLURGICAL LABORATORY.

This laboratory is equipped with apparatus for the study of the quantitative relations of the various agencies taking part in metallurgical changes.

The Junker, the Mahler Bomb, and the Parr calorimeters, the Wanner optical and the Le Chatelier electrical pyrometers, together with sets of the American Gas Furnace Company's gas furnaces, and Hoskin's gasoline furnace are used for securing the desired temperature for experimentation. These furnaces also serve for the necessary assaying demanded in the metallurgical laboratory. Desks and apparatus are provided for small scale work in amalgamation, chlorination, and cyanidation, while for larger scale work a battery for eight amalgamation pans, devised to be operated together or independently by power, several sets of cyanide tanks, including a Braun Laboratory Cyanide plant, and a chlorination barrel, are provided. There is also a Hendryx combined agitator and filter, and a Hendryx agitator for hydro-metallurgical treatment of copper ores.

ORE DRESSING LABORATORY.

The equipment of the ore dressing laboratory, which is rapidly increasing, at present consists of the following apparatus: Sturtevant roll jaw crusher, Colorado Iron Works rolls, Foerster crusher, Case crusher, Bosworth crusher, Vezin disc pulverizer, Braun's perfection crusher, Braun's disc pulverizer, Braun's Chipmunk crusher, Braun's sampling machine, Denver Engineering Works sample grinder, Wilfley table, Card concentrating table, accelerated pulsation jig, set of spitzkasten and all the necessary apparatus for systematic sampling of large and small parcels of ore, and a Blake-Morscher electrostatic separator.

For small scale work, Munroe's slime table, Vezin jig, Munroe classifiers, and other devices, are supplied.

ASSAY LABORATORY.

This laboratory is well equipped with parting, balance, and store rooms and office, and has thirty-two coal-fired muffle furnaces. Each student has his own muffle, with his own coal bin, pulp balance, and desk, conveniently arranged with regard to his furnace; he has also access in the balance room to the best assay balances to be obtained on the market.

A recent addition to the building has increased the available furnace room by fifty per cent, and this added space has been utilized by the installation of an equipment of the most recent types of gasolene furnaces. The list includes one crucible, four combination, and three muffle furnaces, one crude oil burner, one tempering furnace, and a bullion and tempering furnace, all of the F. W. Braun & Co. type; also three Case muffle furnaces, and one Case crucible furnace, two Braun cupel machines, two Iler cupel machines and two bullion rolls, one of which is of the Braun type. In order to avoid dust, change of temperature, and direct sunlight, the balance room has no outside walls, and is lighted by means of skylights. The equipment here includes four special pulp balances, five silver, three gold balances, and one Thompson multiple rider balance. The variety of makes is as great as possible, so as to acquaint the student with the various mechanisms and adjustments in assay balances.

MINING LABORATORY.

The laboratory work in mining is carried on principally at the tunnel belonging to the college. The equipment here consists of numerous drills which are taken apart, reassembled and used by the student; forges, anvils and tools for blacksmithing; the air receiver, valves, gages, fuses and switches connected with the compresser air and electric power transmission from the power plant: a mining car; materials for track laying; and all other supplies usually found at a tunnel house.

Among the makes of rock drills used by each student are: Rand, Ingersoll, Sergeant, Leyner, McKiernan, Wood, Hardsocg, Shaw, Waugh, and Temple-Ingersoll. All of the mountings, such as bars, tripods and arms, and a supply of drill steel, are also provided.

In the laboratory at the school are: two working size models of the Bleichert system of aerial trams donated by the Trenton Iron Works Company; numerous models of mines; an explosive tester; a collection of rock cores taken by diamond drills; models of timbering methods; many maps of actual mines; instruments for measuring ventilation; thousands of lantern slides illustrating mining operations; samples of wire ropes and drill steels; collections of typical rocks and ore from famous districts and mines; lamps of the open and safety patterns; and many photographs.

CEMENT LABORATORY.

The apparatus in this laboratory consists of a twelve hundred pound Riehle testing machine for testing briquettes in tension. A nest of sand sieves gages the sand used in tests. Standard Ottawa sand is used for briquettes as well as the local river sand in order to compare the latter with standard tests. Scales and volumeters are provided for measuring quantities in bulk. The specific gravity of cement is determined by means of Le Chatelier apparatus. A nest of fineness sieves and a very sensitive set of scales equip the student for the fineness test. Setting is determined by means of the complete Vicat apparatus. Trowels, spatulas, large slate mixing boards, beakers, moulds, damp box, and immersing vats, provide apparatus for the making and setting of briquettes and for the soundness tests. Moulds are used for making cubes of concrete for compression tests. Glass baths for chemical tests, trays for heaviness tests, and other general facilities, permit the most extensive investigations.

An apparatus has been devised for use in this laboratory to determine the adhesion between the cement and re-enforcing steel independently of the friction between them due to the shrinkage of the concrete.

HYDRAULIC LABORATORY.

The hydraulic laboratory contains weirs and orifice tanks for the determination of coefficients of discharge, calibrated tanks for water measurement, a steel pressure tank for artificial heads, pumps for water supply, and gages for pressure. A hydraulic ram is used to illustrate this class of apparatus and for testing. A long sheet iron trough, with a car over it is used for calibrating current meters. Water wheels and centrifugal pumps are tested for efficiency under various conditions of head and load. A swinging tank is used to measure jet reactions. Friction losses in pipes, and elbows are measured. Hook gauges are used for the accurate determination of low heads. Streams and ditches in the vicinity of Golden are gauged by means of the current meter, by rod floats, by slope, and by Pitot Tube.

ELECTROMETALLURGICAL LABORATORY.

The electrometallurgical laboratory is located in the basement of the Hall of Physics. It consists of a main room, adjoining which are the storage battery room, a room for cleaning, polishing, and electroplating, and a room for pyrometry and high temperature work.

The main laboratory covers a space of 25 by 45 feet and contains sixteen desks. Each desk is fully equipped with voltmeters, ammeters, rheostats, and terminals leading to a central switchboard where connections may be made to a full set of storage cells, direct or alternating current, and two large wire rheostats.

Besides platinum electrodes, stirring devices, rotating anodes and all such chemical apparatus as is necessary for electro-chemistry, there is a complete equipment of electrical apparatus for studying the principles and conditions involved in electrolytic plants and electrical furnace work.

When a student has completed this course it is expected that he shall be in a position to investigate and understand all the conditions relating to an electrolytic plant, such as density of solutions, temperature effects, and the nature of different electrodes and electrolytes, also all the principles involved in the use and correction of pyrometers, the conversion of electrical energy into heat, and the efficiency of electrical furnaces. A few simple alloys are made and then such properties tested as their coefficient of elasticity, coefficient of heat expansion, resistance, temperature coefficient of resistance, and whatever magnetic properties they may possess.

All the apparatus is arranged so that it may be available for research or investigation along any of these lines.

ELECTRICAL LABORATORY.

This laboratory is equipped with standard voltmeters, ammeters and wattmeters, inductive and non-inductive resistances for artificial loads, a Thomson apparatus for induction experiments, a slip indicator for induction motors, an automatic speed recorder which can be used for finding the acceleration curves of motors, an Alden absorption dynamometer for motor testing, a contact apparatus for alternating current and voltage wave form, a split phase rotary field apparatus, a 10,000 volt oil switch in a glass receptacle so that its action may be observed, a horn break cutout, tank and transformers used in insulator tests.

The generators available for laboratory work include a 75 K. W. Bullock twin unit continuous current generator set, driven by a 110 H. P. De Laval Turbine, a 30 K. W. 1100 volt, 125 cycle, single phase General Electric alternator, a 15 K. W. 130 volt compound, continuous current generator designed and built at the school, a 6 K. W. 130 volt Westinghouse generator, a 2 K. W. 120 volt compound Brush machine, a series arc light machine, and a small Edison shunt generator.

The Bullock generators can be connected at the switchboard to supply the 120-240 volt 3 wire lighting and power circuits, or they can be put in parallel and thus supply over 600 amperes for electro thermic work.

The motors include a 10 H. P. 220 volt 60 cycle, 3 phase constant speed induction motor of General Electric make, a 5 H. P. 3 phase, two-speed induction motor used for electric drilling, a 5 H. P. 3 phase variable-speed induction motor for pumping and hoisting, a 4 H. P. single phase Wagner motor, a 400-2000 R. P. M. variable speed experimental motor designed and built at the school, a 20 H. P. series motor, and a large number of shunt machines of standard makes in daily use about the shops and buildings. Two storage batteries of 54 cells each are in daily use and are available for study.

MECHANICAL ENGINEERING LABORATORY.

The Heating, Lighting, and Power Plant is well equipped for mechanical engineering laboratory practice. The boiler room contains the following principal equipment: a 200 H. P. and a 100 H. P. Babcock and Wilcox boiler, each equipped with a chain grate; a 100 H. P. tubular boiler equipped with plain grate; Green fuel economizer, independently-fired superheater, B. & W. type; Webster feed-water heater, boiler feed and vacuum pumps and injectors; a 125 by 5 foot self-supporting steel stack, and eight 25-ton independent steel bunkers for coal storage.

The engine room is equipped with the following principal apparatus: 50 H. P. high speed Russell engine belted to generator and equipped independently for Prony break tests; 15 H. P. Sturtevant engine belted to generator; 75 K. W. De Laval turbine geared to generator; J. George Leyner two-stage air compressor—capacity 275 cu. ft. free air per minute; a small portable gas engine, and a 10 H. P. Fairbanks, Morse Co. gas engine equipped for tests.

The laboratory is equipped with complete outfits for testing boilers, engines, turbines and compressors, and with such smaller apparatus as indicators, steam calorimeters, gages and gage testers, and speed counters.

PHYSICAL LABORATORIES.

The physical laboratories are composed of three laboratories located in the Hall of Physics. The laboratory for Mechanics and Light is located on the first floor. Adjoining is a balance and instrument room and a dark room containing a complete Lummer-Brodhun photometer and an optical bench. On the second floor are the laboratories for Electricity and Magnetism, and for Heat and Sound. The equipment is particularly adapted to the instruction of students of engineering, being designed to teach the principles of elasticity and efficiency of machines, composition and resolution of forces, various forms of motion, density, velocity and pitch of sound, focal length of lenses, magnifying power, and the principles of the construction of telescopes. The heat laboratory is particularly well equipped for calorimetry, heat expansion determinations, and for the determining of the mechanical equivalent of heat. A complete line of galvanometers, standard resistances, condensers, ammeters, voltmeters, dynamometers, permeometers, standard cells and a Kelvin balance compose the Electrical apparatus, while in magnetism all the principles which underlie the construction of magnets for lifting purposes and the separation of ores, are demonstrated in the laboratory.

MATERIALS OF CONSTRUCTION. TESTING LABORATORY.

The laboratory is provided with a motor-driven 100,000-pound Riehle testing machine arranged for experiments in tension, compression, shearing, and flexure of materials of construction. Extensometers for measuring elongations and compressions are employed. Numerous steel sections provide useful problems in determining centers of gravity and moments of inertia. Experiments to determine the strength of threaded bolts, riveted joints, welds, and nailed joints are included in the course. Tests of specific gravity and absorption of porous building materials such as brick and stone are also made.

CHEMICAL LABORATORIES.

The Freshman, Sophomore and Junior laboratories accommodate two hundred sixty-five students, and are equipped with especially designed tile-topped oak desks, provided with low reagent shelves, gas, water, filter pumps, and large porcelain sinks. The balance rooms are equipped with Sartorius, Becker, and Spoerhase balances. Gas is supplied to the building from a 300-light Detroit gas machine, which is connected with buried supply tanks outside the buildings. Good ventilation is obtained by means of two Sturtevant fans.

Gas Analysis Laboratory. Throughout the day the room affords an even temperature and is well lighted. Window space is reserved for a Lothar Meyer modification of the Bunsen eudiometer and a cathetometer. The laboratory also contains a complete Hemple and Elliott outfit, together with special apparatus for the collecting, storing, and handling of gases.

Water Analysis Laboratory. This laboratory adjoins and communicates with the gas analysis laboratory, and contains a full equipment of ordinary and special apparatus for water analysis. It is situated apart from the general laboratories and is particularly free from contaminating fumes.

SURVEYING EQUIPMENT.

The equipment of the department of surveying is well adapted to the practical course given. Students are organized into parties for field work. Each party is assigned instruments, rods, flags, steel measuring tapes, marking pins, and such other essentials as may be necessary. Students are required to furnish note books, hatchet, and extra plumb-bobs. For transit work there are twenty-five light mountain transits, six of which are provided with solar attachments for determining the meridian and latitude, and eleven of them are provided with auxiliary telescopes for underground work. There are also three heavy transits, one of which is of English and one of German make. In addition to the transits there are two plane tables for taking topography.

For leveling, seven wye levels and five dumpy levels of standard manufacture are used. The department is well supplied with leveling rods of various makes and types, stadia rods, hand levels, clinometers, flagpoles, and other accessories.

The instruments noted above are manufactured by such well-known firms as C. L. Berger & Sons, Buff & Buff, Heller & Brightly, Eugene Dietzgen & Co., Peter Herr & Co., W. and L. E. Gurley, Keufel and Esser, William Ainsworth & Sons, Weiss and Heitzler, Young and Sons, Negretti and Zambra (English), and Max Hildebrand (Freiberg, Germany). Additions are constantly being made to keep pace with the growth of the school and to replace worn-out instruments.

MUSEUM OF APPLIED CHEMISTRY.

The Museum of Applied Chemistry is located on the first floor of the Hall of Chemistry. The object in establishing this museum is to aid in a practical way the courses in applied chemistry and metallurgy. Mounted specimens of raw materials, main products, by-products, and waste products of the various branches of technical chemistry and metallurgy are a direct stimulus in the study of these branches. The specimens already collected for the museum represent, among other things, the various stages of the manufacture of brick, tile, cement, electrolytic alkalis, natural alkalis, electric furnace products, carborundum, alundum, carbide, rare metals, and ferro alloys.

DRAWING ROOMS.

Freshman. This occupies the top floor of the Hall of Chemistry. The floor area is about four thousand square feet. It is lighted by windows on the north, east and west, and by eight large skylights in the roof. A suitable office for the instructors is located in a central position, in which all drawings are filed and all records are kept. Each student is provided with a drawing table, a drawer, a drawing board, and a stool. The present equipment accommodates about one hundred fifty students. There are a great many models to aid the students in their work.

Junior and Senior. The entire third floor of Stratton Hall is used for the Junior and Senior drawing. The room is 90 by 60 feet, lighted by windows and a large skylight. Each student is provided with a drawing table, a drawer, a drawing board, and a stool. Most of the drawing tables are independent and adjustable. The room has recently been equipped with specially constructed tables for the advanced work of the Seniors. The present equipment accommodates about one hundred sixty students. There is a blue print room fully equipped with an adjustable printing frame and all other necessary appliances. In one corner of the room is located the office of the instructors where all drawings and records are filed. There is for the use of the students a complete set of catalogues and a great many blue prints from outside concerns. These are kept up to date.

EXPENSES.

TUITION.

The Statutes of Colorado provide as follows:

> "The said School of Mines shall be open and free for instruction to all bona fide residents of this State, without regard to sex or color, and, with the consent of the Board, students from other states and territories may receive education thereat upon such terms and at such rates of tuition as the Board may prescribe."

The tuition for non-residents is one hundred fifty dollars per year, payable in two instalments—seventy-five dollars at the beginning of each semester.

FEES AND DEPOSITS.

Deposits are required to cover the cost of supplies consumed, and any unused balance is returned. Fees are charged to cover not only the cost of materials furnished, but also the wear on apparatus and supplies. No part of a fee is returnable.

Matriculation Fee (Paid once only)	$ 5.00
Drawing Deposit (Paid once only)	2.00

FRESHMAN YEAR.

First Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee	.50
Qualitative Analysis Fee	20.00
Qualitative Analysis Deposit	15.00

Second Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee	.50
Qualitative Analysis Fee	20.00
Surveying Fee	5.00

Sophomore Year.

First Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Quantitative Analysis Fee	10.00
Quantitative Analysis Deposit	15.00
Mineralogy and Blowpipe Fee	15.00
Physics Laboratory Fee	5.00
Surveying Fee	5.00

Second Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Quantitative Analysis Fee	10.00
Physics Laboratory Fee	5.00

Junior Year.

First Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee	.50
Assaying Fee (Mining Engineering only)	20.00
Assaying Deposit (Mining Engineering only)	25.00
Metallurgical Chemistry Fee (Met. Eng. only)	10.00
Metallurgical Chemistry Deposit (Met. Eng. only)	15.00
Testing Laboratory Fee (Met. Eng. only)	3.00
Materials of Construction Testing Lab. Fee (Met. Eng. only)	3.00
Electrical Laboratory Fee (Met. Eng. only)	5.00

Second Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee	.50
Lithology Fee	3.00
Assaying Fee (Metallurgical Engineering only)	20.00
Assaying Deposit (Metallurgical Engineering only)	25.00
Materials of Construction Testing Lab. Fee (Min. Eng. only)	3.00
Electrical Laboratory Fee (Mining Engineering only)	5.00

Senior Year.

First Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee	.50
Ore Dressing Fee	5.00
Ore Dressing Deposit	5.00

Electrometallurgy Laboratory Fee (Metallurgical Eng. only)	$ 5.00
Electrometallurgy Deposit	5.00
Hydraulic Laboratory Fee	2.00
Cement Laboratory Fee	2.00
Steam Laboratory Fee	5.00
Metallurgical Laboratory Fee (Metallurgical Eng. only)	5.00

Second Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee	.50
Metallurgical Laboratory Fee	5.00
Electrometallurgy Lab. Fee (Metallurgical Eng. only)	5.00
Mining Laboratory Fee (Mining Engineering only)	5.00
Thesis Fee	5.00
Graduation Fee	6.00

TEXT-BOOKS AND STUDENTS' SUPPLIES.

The cost of text-books and students' supplies necessarily varies, but the following is a fair estimate:

Freshman Year:	Text-Books	$15.00
	Drawing Supplies	20.00
Sophomore Year:	Text-Books	15.00
Junior Year:	Text-Books	20.00
Senior Year:	Text-Books	15.00

BOARD AND LODGING.

The college has no dormitory. Board can be obtained in private families at from four to six dollars per week. Students' clubs furnish board at about sixteen dollars per month. Rooms can be obtained at from six dollars to twelve dollars per month.

OTHER EXPENSES.

There are other expenses incidental to the mining, metallurgical, and geological trips, which vary so widely that they cannot be estimated. The preparation of the Senior thesis also involves expenses which vary with the nature and treatment of the subjects. For laboratory work in special cases a deposit of fifteen dollars is required. Students leaving in mid-term, except on account of severe protracted sickness, are not entitled to the return of fees or tuition. *All charges of the college are payable strictly in advance at the beginning of each semester.* No student is allowed to be graduated while indebted to the school. The Trustees reserve the right to make incidental changes in fees and deposits without printed notice, as new and unforeseen emergencies may arise.

Students who desire to earn money to defray their college expenses are advised to limit their work to the summer vacation. The course of study is too exacting to allow much time during the college year for outside work.

The total expenses of the college year, exclusive of tuition, need not exceed four hundred dollars, and may, by strict economy, be considerably reduced.

GENERAL INFORMATION.

DEGREES.

The college offers two four-year courses—Mining Engineering and Metallurgical Engineering—leading to the degrees of E. M. (Mining Engineer) and E. Met. (Metallurgical Engineer).

Also two two-year postgraduate courses leading to the degrees of E. M. and E. Met.

THESIS AND GRADUATION.

A thesis upon some suitable subject is a prerequisite to the completion of either course. Each senior must submit to the Faculty, not later than November 1st, the subject of his thesis, which must be approved by the Professor concerned. Each thesis must be typewritten or printed on eight and one-half by eleven-inch paper, bound in book form, and submitted not later than May 1st.

No diploma will be delivered until the thesis is handed in, the full requirements of the course of study are satisfied, and all accounts with the college are settled.

METHODS OF GRADING.

The following system of grading is used:

A—Excellent.
B—Good
C—Fair.
D—Conditioned.
E—Failed.

A, B and C are passing grades.

D (Conditioned) means that the student is not passed. The deficiency may be removed by passing an examination or otherwise completing the work. Unless a condition is removed before the beginning of the school year following the year in which the condition is given, it becomes an E, and the subject must be taken again. This rule may be waived in a merited case by special Faculty action.

E (Failed) means that the subject must be repeated and no advanced subject which depends on this one can be taken until the E is removed.

A student who, at the close of any semester, has conditions, that is, D's or E's, or both, amounting to a total of twelve hours work a week, may not remove any of the conditions by re-examination, but must, in each case, repeat the course. In this connection a three-hours laboratory or drawing period is regarded as the equivalent of one hour's work. Furthermore, in case a student fails to complete his work by the close of a semester, but the deficiency is such that it can be made up by a small amount of work, the instructor returns to the office not a D but an "incomplete," which is designated by the letters "Inc." This is not regarded as a condition in the sense used above.

No student may take any Junior subject until he has received credit in all Freshman subjects. No student may take any Senior subject until he has received credit in all Freshman and Sophomore subjects. In case of students admitted to advanced standing these rules may be suspended during the first year of their attendance, but advanced standing students are required to take all regularly scheduled trips not covered by accepted credits at the earliest opportunity offered.

SPANISH.

In response to the demand from students who expect to pursue their vocation in Mexico, a private class in Spanish is conducted by Mr. E. W. Enriquez, a native Spaniard.

LIBRARY.

The library, which numbers over nine thousand volumes and about five thousand pamphlets, is primarily of a technical nature and is being increased along lines corresponding with instruction in the college. Direct access to the shelves is permitted to all students in order that they may secure the benefit of examining the books themselves. Books which are not needed for special reference work are loaned for home use for a period of two weeks. The card catalogue includes entries under author, title, and subject, arranged on the dictionary plan. The classification is an adaptation of the Dewey decimal system to the needs of a technical library.

The library receives the publications of the leading scientific societies of the world, and the chief literary and scientific periodicals. It is especially rich in files of journals relating to the various branches of mining engineering, and receives as gifts the maps and various publications of the United States Geological Survey, a number of other United States documents, and reports of various state geological surveys and mining bureaus.

The library is open from 8 to 12 a. m., 1 to 5 p. m., and 7 to 9:30 p. m., with the exception of Sundays and legal holidays.

VINSON WALSH RESEARCH FUND.

On May 22, 1908, Mr. Thomas F. Walsh, of Littleton, Colorado, gave to the school the sum of one thousand dollars to be known as the "Vinson Walsh Research Fund," in memory of his son Vinson Walsh. Under this gift a Department of Research has been established under the charge of Professor Herman Fleck, assisted by Mr. Sidney W. French, Fellow in Metallurgy. At the present time the rare metals of Colorado are being explored and investigated.

PRIZES.

At the Commencement Exercises, May 22, 1908, the following prizes were awarded:

Pocket Transit from Mr. D. W. Brunton, and Aneroid Barometer from the Cardwell Blue Print and Supply Company to William Reuel Chedsey and Charles Alexander Langrall. Thesis: The Geology of a Section near Sedalia, Colorado.

$50 from "The Mining and Metallurgical Journal" (formerly "Mines and Mining"), to Herbert Austin Everest. Thesis: Tunneling Machinery.

$50 from "Mines and Minerals," to Herman Charles Zulch and Thomas Samuel Harrison. Thesis: Court Maps and Models.

$50 from "Mining Science," to Harold Hutchinson Goe and Sidney Willis French. Thesis: The Concentration of Tungsten Ores.

$100 from Mr. Frank Bulkley, to William Ashby Jones, Jr., and Lawrence C. Page. Thesis: A Report on the Old Town Mine, Idaho Springs, Colorado.

The "Edward C. Stoiber Prizes," $100, to Carl Eugene Lesher. Thesis: The Electrothermic Reduction of Zinc.

And $150 to Frederick F. Frick, Arthur John Weinig, and James Bennett Lowell. Thesis: Copper Converting.

The Governor's Prizes for general scholarship, character, and school loyalty, from Gov. Henry A. Buchtel, $25 each, to Robert Baxter Elder and Benjamin Wallis Knowles.

SCIENTIFIC SOCIETY.

The Scientific Society has for its object the presentation and discussion of technical and engineering subjects. Original papers are prepared and read before the society by its active members. The editorial staff has in operation a comprehensive system for the review of current technical literature and the bringing before the society of the noteworthy and salient questions of the day. The addressing of an assembly by the students insures the stimulation of confidence, which is so essential to the technical and profesional man. From time to time, lectures are delivered before the society by the leading authorities on various topics of primary interest to its members and friends. The proceedings of the society are printed in its official publication, "The Bulletin," which is issued twice during the college year. The Alumni, Faculty, Senior, and Junior classes of the college constitute the active members of the organization, while the Sophomores and Freshmen are associates.

Meetings are held at least once a month in Simon Guggenheim hall.

Officers for the year 1908-09 are:

President, Joseph J. Weisz, '09.
Vice-President, Eugene C. Brooks, '09.
Secretary, Oliver R. Taggart, '09.
Treasurer, De Mont G. Miller, '09.

SOCIAL CLUB.

Social life in the college is fostered by a regularly appointed body of students consisting of three members from each class. Several receptions during the year are given under their management.

Officers:

President, Louis Schafer, '09.
Vice-President, Herman A. Kruger, '09.
Secretary and Treasurer, W. C. J. Rambo, '09.

COLLEGE BAND.

A band of twenty-five pieces under the leadership of George M. Kimball of Golden, renders valuable assistance at athletic games.

ATHLETIC ASSOCIATION.

By virtue of the athletic fee required of all students, all students regularly entering the School of Mines become members of the Athletic Association. The association is supported by the students' fees, by gate receipts, and by contributions from the alumni and other friends of the college. The treasurer of the school, Harry M. Rubey, Woods-Rubey National Bank, selected by the Board of Trustees is, *ex-officio*, treasurer of the association. The affairs of the association are managed by a board of control, which consists of seven members; three undergraduates elected by the students, an alumnus selected by the alumni association, and three members of the faculty selected by the president of the school.

The Board of Control for 1908-9 is:

Professor H. B. Patton, President.
Professor Charles R. Burger, Vice-President.
John A. Weir, '09, Secretary.
Arthur Hodgson, '99.
Hamilton W. Baker, '10.
James A. Lannon, '11.

Y. M. C. A.

The purpose of the College Y. M. C. A. is to promote Christian character and high ideals of life among the students. In accordance with its motto, "Spirit, Mind and Body," the Association believes that such a threefold development is essential to the equipment of a well rounded man. Membership is open to all members of the school and to the Faculty. Permanent headquarters are maintained in Guggenheim Hall. An employment bureau is maintained for the benefit of students who desire work during the year. Likewise the Association conducts a room and board bureau during the opening days of school, for the benefit of new students. Help that can be given in any way is gladly offered. A hand-book of information is published annually, a copy of which can be secured by writing to the General Secretary. An advisory board consisting of two members of the Faculty, one minister, one business man, and an alumnus, has general supervision of the entire work.

Officers for 1908-9—Duane C. Kelso, President; Howard J. Hilton, Vice-President; Harry M. Showman, Recording Secretary; John R. Griffith, Treasurer; Earl R. Hibbard, General Secretary.

Advisory Board—Prof. Horace B. Patton, Prof. William F. Alison, Dr. Walter J. King, C. Lorimer Colburn, '07; Rev. Ira Hall.

ALUMNI ASSOCIATION.

The Association of the Alumni holds its annual meeting and banquet on the day following the commencement exercises, unless otherwise provided by the Executive Committee. All graduates holding degrees are eligible to membership, and are invited to the annual meeting and banquet.

The aim of the Association is to promote acquaintance and friendship among the graduates, to encourage them to aid each other, and to make an organized effort to elevate and uphold the reputation and standard of their Alma Mater.

All graduates are earnestly requested to join the organized body and to keep the Secretary advised as to their addresses.

The officers of the Association are:

Lewis B. Skinner, '95, President.
James H. Steele, '00, Secretary, P. O. Box 236, Denver, Colo.
Walter E. Burlingame, 01, Treasurer.

GIFTS.

Miscellaneous.

American Blower Company, Detroit, Mich.
Framed picture.

Continental Color and Chemical Company, New York, N. Y.
Samples of new colors.

COLORADO SPRINGS AND CRIPPLE CREEK RAILROAD COMPANY.
Framed picture.

SULLIVAN MACHINERY COMPANY, Denver, Colo.
Sullivan Air Drill complete with tripod.

R. THOMAS & SONS COMPANY, New York, N. Y.
Three porcelain high tension insulators.

MAX BOEHMER, Denver, Colo.
Mine model.

DUNCAN BOND, Denver, Colo.
Framed picture of Beall Bros. miners' tool works.

U. S. GEOLOGICAL SURVEY.
Plans and Specifications of public works.

LOCKE INSULATOR MANUFACTURING COMPANY, Victor, N. Y.
Two porcelain insulators.

SIGHT FEED OIL PUMP COMPANY, Milwaukee, Wis.
Oil pump.

THE BRISTOL COMPANY, Waterbury, Conn.
Sample board of steel belt lacing.

LARIMER HEATING AND PLUMBING COMPANY, Denver, Colo.
Gageboard, clock, and gages.

ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa.
Chloride accumulator.

NATIONAL BATTERY COMPANY, Buffalo, N. Y.
Exhibition board of Unit Accumulator.

DAYTON HYDRAULIC MACHINERY COMPANY, Chicago, Ill.
Through Paul S. Rattle, District Manager.
Brooks centrifugal pump.

MINNEAPOLIS STEEL AND MACHINERY COMPANY, Minneapolis, Minn.
Through J. B. Gilman, Chief Engineer.
Blue prints of head frames and mill buildings.

A. LESCHEN & SONS ROPE COMPANY, St. Louis, Mo.
Sample board of wire ropes.

SOUTHERN PACIFIC R. R. COMPANY, Denver, Colo.
Through W. K. McAllister, General Agent.
Six framed pictures.

CHICAGO, BURLINGTON & QUINCY R. R., Denver, Colo.
Through J. F. Vallery, General Agent.
Three framed pictures.

EUREKA DRILL STEEL COMPANY, Denver, Colo.
Through Thomas J. Barbre, President.
Set of Eureka Drill Steel.

HOLLEY BROTHERS COMPANY, Detroit, Mich.
The Holley Carburetor.

Hendrie & Bolthoff Mfg. & Supply Company, Denver, Colo.
Framed picture of the Aldrich sinking pump.

American Bridge Company, New York, N. Y.
Through H. J. Burt, Contracting Manager.
Blue prints and pictures of head frames.

Attica Bridge Company, Attica, Ind.
Through G. B. Curtis, Secretary.
Blue prints of mill buildings and bridges.

Power and Mining Machinery Company, Cudahy, Wis.
Through H. F. Jurs.
Six framed pictures.

Foster Engineering Company, Newark, N. J.
Through C. S. Goertner, Secretary.
Model of pressure regulator.

James H. Barry, Denver, Colo.
Cane made from the horn of a rhinoceros.

Alumni of the School.
Oil portraits of Dr. Regis Chauvenet and
Senator Simon Guggenheim.

A. B. Frenzel, Denver, Colo.
Aneroid barometer made by Cassella, London.
Steward's Telemeter.

Colorado Fuel and Iron Company, Denver, Colo.
Through J. F. Welborn, President.
Framed picture of the Bessemer plant.
Samples of coal and coke.

Connersville Blower Company, Connersville, Ind.
Cycloidal and involute models.

D. and W. Fuse Company, Providence, R. I.
Through W. S. Sisson, Secretary.
Sample board of fuses.

Toledo-Massilon Bridge Company, Toledo, O.
Blue prints of bridges.

Lake Tahoe Railway and Transportation Company.
Three framed pictures of Lake Tahoe.

Missouri Valley Bridge & Iron Company, Leavenworth, Kas.
Blue prints of bridges.

Dorsey and Hodges, Attorneys, Denver, Colo.
Model of the Stratton Independence Mine.

Pacific Improvement Company, San Francisco, Calif.
Framed picture of Hotel del Monte.

Pennsylvania Salt Manufacturing Company, Philadephia, Pa.
Framed picture of the Wedge mechanical roaster.

FAIRBANKS MORSE COMPANY, Denver, Colo.
16 H. P. Gas Engine.

WESTERN MOTOR COMPANY, Logansport, Ind.
Rutenber carburetor.

WHITNEY-STEEN COMPANY, New York, N. Y.
Through F. C. Carstarphen.
Models.

THE LUNKENHEIMER COMPANY, Cincinnati, O.
Collection of sectioned valves.

INTERNATIONAL ACHESON GRAPHITE COMPANY, Niagara Falls, N. Y.
Collection of samples.

TRUSTEES OF THE ESTATE OF W. S. STRATTON, Colorado Springs, Colo.
Bronze bust of Mr. Stratton.

WHEELER AND SCHEBLER, Indianapolis, Ind.
Schebler Carburetor.
Automatic check valve.

P. D. CUPLIN, West Bend, Ia.
Cuplin Separator.

MORGAN CONSTRUCTION COMPANY, Worcester, Mass.
Framed picture of the Morgan continuous gas producer.

PENNSYLVANIA RAILROAD COMPANY.
Through W. F. George, Passenger Agent, Denver, Colo.
Framed picture of the Congressional Library.

BLAKE MINING AND MILLING COMPANY, Denver, Colo.
Through W. G. Swart.
Blake-Morscher Electrostatic Separator.

HENDRYX ELECTRO-CYANIDE COMPANY, Denver, Colo.
Hendryx agitator and slime filter, combined.
Hendryx agitator for the hydrometallurgical treatment of copper ores.

CHARLES A. SCHIEREN AND COMPANY, New York, N. Y.
Sample board of leathers.

SANFORD-DAY IRON WORKS, Knoxville, Tenn.
Sample wheel and axle.

THOMAS L. WORD, Denver, Colo.
Leyner Rock Drill with water tank.

HARRY M. RUBEY, Golden, Colo.
Mounted eagle.

E. A. COOPER, Denver, Colo.
City Ticket Agent, C. & S. R. R.
Three framed pictures.

THE JEFFREY MANUFACTURING COMPANY, Columbus, O.
Eight framed pictures.

ALTHA TOOL COMPANY, Newark, N. J.
One dozen prospecting picks and hammers.

ASSISTANT PROFESSOR W. J. HAZARD, Golden, Colo.
Thomson Induction Apparatus.

WESTERN LUBRICATING VALVE COMPANY, Denver, Colo.
Through Thomas J. Barbre, President.
Lubricating valve.

ORES, MINERALS, AND ROCKS.

D. H. DUNSHEE, Butte, Mont.
Covellite and chalcopyrite.

F. L. BARKER, C. S. M. '06.
Native silver from tbe Coronado Mine, Leadville.

J. E. NORMAN, C. S. M. '98.
Wulfenite crystals.

E. M. RABB, C. S. M. '05.
Pyrite crystals, chalcopyrite, from Sonora, Mexico.

WILLIAM MAGENAU, C. S. M. '98.
Sulphur and gypsum from Cody, Wyo.

PROFESSOR F. W. TRAPHAGEN, Golden, Colo.
Shelite from Coeur d'Alene Mountains, Idaho.

M. H. KILGORE, C. S. M. '08.
Cobalt ores and native silver from Cobalt, Ontario.

PROF. HERMAN FLECK, Golden, Colo.
Crystallized wolframite from Boulder County, Colo.

M. J. MILLER.
Stream tin from the Black Hills, Dakota.
Corundum crystal from Montana.

JOHN G. MAY, C. S. M. '01.
Crystallized wolframite from Boulder County, Colo.

H. C. ARMINGTON, C. S. M. '07.
Goslarite from the Wolftone Mine, Leadville.

C. P. CRAMER, C. S. M. '99.
Native copper and cuprite crystals from Fierro, N. M.

W. F. R. MILLS, Denver, Colo.
Crystallized galena from Joplin, Mo.

ALLAN PATTERSON, Fairview, Nev.
Gold and silver ore.

R. P. FRANK, C. S. M. '04.
Pyrite crystals from Sonora, Mexico.

M. W. ATWATER, C. S. M. '01.
Crystallized cassiterite and native copper from Bolivia.

DOUGLAS MUIR, C. S. M. '05.
Native copper from Descubridora, Dgo., Mexico.

R. L. D'ARCY, C. S. M. '05.
Silver ore from Wonder district, Nevada.

J. A. SNEDAKER, Denver, Colo.
Copper ores from Ely, Nev.

C. H. CARPENTER, C. S. M. '09.
Cobalt ore from Cobalt, Ontario.

B. G. STROCK, Kerby, Oregon.
Josephinite from Josephine County, Ore.

HUGH R. VAN WAGENEN, C. S. M. '06.
Crystallized fluorite from Dome, Ariz.

JOHN R. SMITH.
Polybasite from Custer County, Colo.

E. H. Platt, C. S. M. '00.
Calcite, copper, zinc, and iron minerals; also miscellaneous minerals.

HUGH C. WATSON, C. S. M. '01.
Crystallized cassiterite, from Bolivia.

E. L. TALBOT, Superintendent.
Cerrussite from the Daly-West mine, Park City, Utah.

M. T. CHESTNUT, Denver, Colo.
Enargite and other ores from San Antonio mine, Ouray, Colo.

J. A. LANNON, C. S. M. '11.
Vivianite from Leadville, Colo.

J. E. DWELLE, C. S. M. '96.
Cervantite from San Luis Potosi, Mexico.

HON. AURELIO HIRIART, Charcas, Mexico.
Cervantite from San Luis Potosi, Mexico.

P. H. MCHUGH, C. S. M. '11.
Garnet from Alaska.

A. C. CARSON, Manager, Butte, Mont.
Copper ores from North Butte Mine, Butte, Mont.

A. J. KOERNER, C. S. M. '06, and S. A. GOODALE.
Copper minerals from Buckskin, Nev.

WALTER F. FERRIER, Montpelier, Idaho.
Miscellaneous minerals.

F. THOMAS & CO., Denver, Colo.
Miscellaneous minerals and ores.

S. B. TYLER, C. S. M. '99.
Ores and rocks from the Jimulco Mining Company, Otto, Coah., Mexico.

Chemical Products.

Samples of raw materials, intermediate and finished products from:

Primos Chemical Company, Philadelphia, Pa.
Van Briggle Pottery Company.
McMurtry Manufacturing Company, Denver, Colo.
International Acheson Graphite Company, Niagara Falls, N. Y.
Picher White Lead Company, Joplin, Mo.
Carter White Lead Company, Omaha, Neb.
Anaconda Copper Company, Brick Department, Anaconda, Mont.
United Oil Company, Florence, Colo.
Inland Oil Company, Boulder, Colo.
Golden Pressed Brick Company.
Colorado Brick and Artificial Stone Company.
Colorado Portland Cement Company.
Du Pont de Nemours Powder Company.

ENROLMENT OF STUDENTS.

POST GRADUATE STUDENTS.

Baker, John A. . . . . *Philadelphia, Pa*
Ph. B. Yale University.

Blatherwick, J. A. . . . . *Denver, Colo.*
B. S. Dartmouth College.

Brooks, Eugene C. . . . . *Boston, Mass.*
B. S. Dartmouth College.

Bryant, John E. G. . . . . *Philadelphia, Pa.*
B. S. University of Pennsylvania.

Burns, Harry M., Jr. . . . . *West Chester, Pa.*
B. S. Pennsylvania State College

Butler, John N. . . . . *Denver, Colo.*
A. B. St. Xavier College.

Cunningham, Benton L. . . . . *Ashland, Ore.*
B. S. Oregon State Agricultural College.

Doyle, D. B. . . . .
A. B., A. M. Princeton University.

Evans, W. W. . . . . *Leadville, Colo.*
E. Met. Colorado School of Mines.

Hibbard, Earl R. . . . . *Golden, Colo.*
A. B. Baker University.

Holroyd, George M. . . . . *Waterford, N. Y.*
A. B. Williams College.

Hunt, Carll W. . . . . *Los Angeles, Calif.*
A. B. University of Southern California.

Hynes, B. D. . . . . *Elgin, Ill.*
B. S. Virginia Polytechnic Institute.

Iwai, Kyosuke. . . . . *Chibakan, Japan*
Graduate of the Imperial Technical College of Tokio, Japan.

Koch, William F. . . . . *Chicago, Ill.*
A. B. St. Ignatius College.

Leeke, Dana W. . . . . *Upland, Calif.*
B. S. Pomona College.

Loveland, Francis P. . . . . *Denver, Colo.*
A. B. Yale University.

McCormick, David F. . . . . *San Antonio, Tex.*
C. E. University of Texas.

Negru, Jaques. . . . . *Denver, Colo.*
E. M. University of Liege, Belgium.

Nettles, George P. . . . . *Marlin, Tex.*
B. S. Southwestern University.

Perkins, Alfred E. . . . . *Otsego, Mich.*
A. B. University of Michigan.

Richards, George L. . . . . *Denver, Colo.*
Graduate of the Sorbonne, Paris.

Robbins, Frank M. . . . . *Cincinnati, O.*
B. S. Denison University.

Russell, Clarence W. . . . . *Oskaloosa, Ia.*
B. S. University of Chicago.

Saunders, Arthur B. . . . . *Milton, Wis.*
B. S. University of Wisconsin.

Smith, Lyon. . . . . *Boston, Mass.*
B. S. Harvard University.

Vacek, Vincent F. . . . . *South Omaha, Neb.*
B. S. Armour Institute of Technology.

Van Wagenen, Hugh R. . . . . *Denver, Colo.*
E. M. Colorado School of Mines.

Winslow, Sidney H. . . . . *Washington, D. C.*
B. S. Alabama Polytechnic Institute.

CLASS OF 1909.

SENIORS.

Class Officers.

President, Louis Schafer.
Vice-President, Blair L. Sackett.
Secretary, Eduardo W. Enriquez.
Treasurer, William J. Hamilton.

Benjovsky, T. Dyer	*Del Norte, Colo.*
Bradford, Albert H.	*Placentia, Calif.*
Brooks, Eugene C. B. S. Dartmouth College.	*Boston, Mass.*
Brugger, A. E. University of Michigan.	*Columbus, Neb.*
Bunger, Milne E. University of Denver.	*Edgewater, Colo.*
Burgess, Charles W.	*Denver, Colo.*
Canning, Walter E.	*Council Bluffs, Ia.*
Carpenter, Cranston H. University of Denver.	*Denver, Colo.*
Clapp, Leroy P. Worcester Polytechnic Institute.	*Melbourne, Australia*
Cunningham, Benton L. B. S. Oregon State Agricultural College.	*Ashland, Ore.*
Curtis, Leroy P. University of Denver.	*Littleton, Colo.*
Doyle, Donald B. A. B., A. M. Princeton University.	*Golden, Colo.*
Eddy, Harold C.	*Denver, Colo.*
Emrich, Clarence T. Colorado College.	*Golden, Colo.*
Enriquez, Eduardo W. Notre Dame University.	*Chihuahua, Mexico*
Farnum, Franklin C. University of Minnesota.	*Minneapolis, Minn.*
Geary, Richard E. University of Oregon.	*Portland, Ore.*

Griffith, John R.................................*Denver, Colo.*

University of Denver.

Hallett, Alfred F.................................*Denver, Colo.*

Hamilton, William J.......................*Santa Barbara, Calif.*

University of Southern California.

Hammond, William L.............................*Saguache, Colo.*

Hansen, Charles L..............................*Fullerton, Calif.*

Hull, C. B..*Denver, Colo.*

Hunt, Harry V. D...............................*Baltimore, Md.*

Baltimore Polytechnic Institute.

Hynes, B. D...*Elgin, Ill.*

B. S. Virginia Polytechnic Institute.

Iwai, Kyosuke..................................*Chibaken, Japan*

Imperial Technical College of Tokio.

Kirchman, Robert I..................................*Gary, Ind.*

New Mexico School of Mines.

Kruger, Herman A. E..............................*Denver, Colo.*

Lewis, W. M...................................*Georgetown, Colo.*

Miller, De Mont G...........................*Los Angeles, Calif.*

University of Southern California.

Negru, Jaques.....................................*Denver, Colo.*

E. M. University of Liege, Belgium.

Patrick, William B................................*Golden, Colo.*

Princeton University.

Rambo, William C. J.............................*Norristown, Pa.*

Ristedt, Ernest J...........................*Idaho Springs, Colo.*

Russell, Donald O..............................*London, England*

Sackett, Blair L..................................*Newark, N. J.*

Schafer, Louis................................*Lake City, Colo.*

Taggart, Oliver R.................................*Denver, Colo.*

Wasley, William A................................*Greeley, Colo.*

Weir, John A......................................*Denver, Colo.*

Weisz, Joseph J.................................*Cleveland, O.*

Wilson, Dudley M.................................*Golden, Colo.*

Wood, Ernest B....................................*Denver, Colo.*

CLASS OF 1910.

JUNIOR CLASS.

Class Officers.

President, Roswell B. Swezey.
Vice-President, John R. West.
Secretary, John H. East.
Treasurer, Jean McCallum.

Allen, Louis M., Jr. . . . . *New York, N. Y.*
Baker, John A. . . . . *Philadelphia, Pa.*
Ph. B. Yale University.
Baker, Hamilton W. . . . . *Manila, P. I.*
Ballagh, J. Courtenay . . . . *Chicago, Ill.*
Armour Institute of Technology.
Barbour, Arthur R. . . . . *Edgewater, Colo.*
Barnett, Walter W. . . . . *Golden, Colo.*
Blatherwick, J. A. . . . . *Denver, Colo.*
B. S. Dartmouth College.
Bradford, Julius S. . . . . *Denver, Colo.*
Brown, Walter R. . . . . *Evanston, Ill.*
Bruderlin, Emil J. . . . . *Denver, Colo.*
Bryant, John E. G. . . . . *Philadelphia, Pa.*
B. S. University of Pennsylvania
Burns, Harry M., Jr. . . . . *West Chester, Pa.*
B. S. Pennsylvania State College.
Campbell, Kent P. . . . . *Boulder, Colo.*
Carman, John B. . . . . *Denver, Colo.*
Carpenter, Paul H. . . . . *Victor, Colo.*
Pennsylvania State College.
Cary, Webster P. . . . . *Denver, Colo.*
Chambers, Horace . . . . *Nashville, Tenn.*
Dyer, Charles E. . . . . *Golden, Colo.*
East, John H. . . . . *Denver, Colo.*
University of Denver.
Colorado Agricultural College.
Engle, Frederick . . . . *Denver, Colo.*
University of Colorado.
Farrar. Russell J. . . . . *Salem, Ore.*
University of Oregon.

Feldman, Samuel A. .... *Denver, Colo.*
Fitz Gerald, Ronald P. .... *Roswell, N. M.*
Foss, Marion H. .... *Waterville, N. H.*
Massachusetts Institute of Technology.
Geringer, George T. .... *Cincinnati, O.*
St. Xavier College.
Glasgow, Charles M. .... *St. Louis, Mo.*
Hall, Sigourney D. .... *Denver, Colo.*
Hibbard, Earl R. .... *Golden, Colo.*
A. B. Baker University.
Hilton, Howard J. .... *Seattle, Wash.*
Hunt, Carll W. .... *Los Angeles, Calif.*
A. B. University of Southern California.
Jones, Ernest F. .... *Las Esperanzas, Mexico*
Jones, Vincent K. .... *Denver, Colo.*
Juchem, Harold H. .... *Edgewater, Colo.*
Keeney, Robert M. .... *Somersville, Conn.*
Massachusetts Institute of Technology.
Kelso, Duane C. .... *Edgewater, Colo.*
Latimer, Bert J. .... *Golden, Colo.*
Iowa State College.
Laughlin, Samuel W. .... *Golden, Colo.*
Lee, Frank W. Jr. .... *Denver, Colo.*
Lee, George M. .... *Golden, Colo.*
Leeke, Dana W. .... *Upland, Calif.*
B. S. Pomona College.
Lesh, Herbert B. .... *Montreal, Canada*
Loveland, Francis P. .... *Denver, Colo.*
A. B. Yale University.
McCallum, Jean .... *Denver, Colo.*
McCormick, David F. .... *San Antonio, Tex.*
C. E. University of Texas.
McKay, Glover S. .... *Townsend, Mont.*
Nettles, George P. .... *Marlin, Tex.*
B. S. Southwestern University.
Nordenholt, George D. .... *Oak Park, Ill.*
Perkins, Alfred E. .... *Otsego, Mich.*
A. B. University of Michigan.
Phelps, Harlow D. .... *Denver, Colo.*
University of Wisconsin.
Pullen, Lester L. .... *Golden, Colo.*
Michigan College of Mines.
Purdy, Irvine A. .... *Golden, Colo.*
Alma College.
Richards, George L. .... *Denver, Colo.*
The Sorbonne, Paris.

Robbins, Frank M. .... *Cincinnati, O.*

B. S. Denison University.

Russell, Clarence W. .... *Oskaloosa, Ia.*

B. S. University of Chicago.

Saunders, Arthur B. .... *Milton, Wis.*

B. S. University of Wisconsin.

Showman, Harry M. .... *Denver, Colo.*

Silver, Leopold .... *Aspen, Colo.*

Skavlen, Henry G. .... *Janesville, Wis.*

Smith, Lyon .... *Boston, Mass.*

S. B. Harvard University.

Soupcoff, Samuel M. .... *Pittsburg, Pa.*

Allegheny College.

Strohl, George F. .... *Greeley, Colo.*

Swainson, Otis W. .... *Denver, Colo.*

Swezey, Roswell B. .... *Chicago, Ill.*

Turpie, Eugene F. .... *Cripple Creek, Colo.*

Vacek, Vincent F. .... *South Omaha, Neb.*

B. S. Armour Institute of Technology.

Watson, Guy P. .... *Greeley Colo.*

West, John R. .... *Greeley, Colo.*

Whitehurst, J. Wesley .... *Salida, Colo.*

Willett, Rob R. .... *Golden, Colo.*

Winslow, Sidney H. .... *Washington, D. C.*

B. S. Alabama Polytechnic Institute.

Zeisloft, Earl A. .... *Akron, O.*

Ohio State University.

CLASS OF 1911.

SOPHOMORE CLASS.

Class Officers.

President, **Gustave W. Voelzel.**
Vice-President and Treasurer, **L. R. J. Davis.**
Secretary, **Morris V. Andre, Jr.**

Adams, James C.	*Steamboat Springs, Colo.*
Andre, Morris V., Jr.	*Guanajuato, Mexico*
Babcock, Frederick A.	*Denver, Colo.*
Banks, Leon M.	*Denver, Colo.*
Blum, Sidney	*Pueblo, Colo.*
Boyle, Willis J., Jr.	*Los Angeles, Calif.*
Brown, Samuel R., Jr.	*Montrose, Colo.*
Brunel, Frank	*Golden, Colo.*
Bryan, Fred T.	*Denver, Colo.*
Calvert, Clarence E.	*Golden, Colo.*
Clausen, S. J.	*Clear Lake, Ia.*
Conant, Roger W.	*Boston, Mass.*
Cummins, Joseph T.	*New York, N. Y.*
Currens, Warren W.	*Denver, Colo.*
Daley, Albert C. Throop Polytechnic Institute.	*Pasadena, Calif.*
Davis, Charles A.	*San Bernardino, Calif.*
Davis, Le Roy J.	*Denver, Colo.*
Decker, Harry P.	*Niles, O.*
Dick, James E. Buchtel College.	*Akron, O.*
Dittus, Edward J. University of Wisconsin.	*Colorado Springs, Colo.*
Douglass, William C.	*Plainfield, N. J.*
Finger, Noble C. University of Denver.	*Fort Collins, Colo.*
Fritch, Frank G.	*Denver, Colo.*
Fullerton, Wilfred	*Denver, Colo.*
Galligan, J. T.	*Idaho Springs, Colo.*
Garnett, Thomas H.	*Pueblo, Colo.*

Geary, E. S.	*Denver, Colo.*
Geib, Karl V.	*Denver, Colo.*
Gilbert, Joseph I.	*Denver, Colo.*
Hager, Edward T.	*Fort Atkinson, Wis.*
Harvey, John V.	*Sioux City, Ia.*
Heil, Harold L. St. Louis College.	*El Paso, Tex.*
Herres, Otto, Jr.	*Denver, Colo.*
Hiester, Arthur J.	*Chicago, Ill.*
Holroyd, George M. A. B. Williams College.	*Waterford, N. Y.*
Jackson, Lester T.	*Denver, Colo.*
Johns, Alfred L. Colorado College.	*Winnemucca, Nev.*
Johnson, Walter	*Golden, Colo.*
Keith, Laurence P.	*Golden, Colo.*
Kissock, Alan	*Summit, N. J.*
Koch, William F. A. B. St. Ignatius College.	*Chicago, Ill.*
Lannon, James A. University of Colorado.	*Pueblo, Colo.*
Laurance, Bert M.	*San Bernardino, Calif.*
Lovejoy, Floyd A.	*Deposit, N. Y.*
Marshall, Emory M. Iowa State College. University of Wisconsin.	*Des Moines, Ia.*
May, Arthur L. Geneva College.	*Beaver Falls, Pa.*
Mayer, Walter J.	*Leadville, Colo.*
McHugh, Philip M.	*Aberdeen, S. D.*
Milton, Samuel L. Harvard University.	*Boston, Mass.*
Moore, C. A.	*Red Cliff, Colo.*
Murchison, Earl H.	*Arvada, Colo.*
Neef, Louis	*Denver, Colo.*
Olsen, Charles O.	*Spokane, Wash.*
Patterson, Arthur L.	*Pueblo, Colo.*
Peirce, Chandler D.	*Denver, Colo.*
Pelton, Harold A.	*Leadville, Colo.*
Roberts, Henry M.	*Denver, Colo.*
Ross, Charles A.	*Custer, Ill.*
Rupert, Allen M.	*Golden, Colo.*
Salisbury, George W.	*Golden, Colo.*
Schneider, August W.	*Denver, Colo.*
Schoder, Jacob, Jr.	*Golden, Colo.*
Shaw, Ralph H.	*Aspen, Colo.*
Skinner, Thomas M.	*Denver, Colo.*

Smith, Roy F.	*Denver, Colo.*
Smith, Warren D.	*Deposit, N. Y.*
Snow, Robert E.	*Greenwood, Colo.*
Spring, Archer	*Upper Gloucester, Me.*
Street, Lloyd G.	*Chicago, Ill.*
Lewis Institute.	
Sullivan, Henry B.	*Denver, Colo.*
Tennant, Melbourne R.	*Golden, Colo.*
University of Denver.	
Van Liew, Fred W.	*Aurora, Ill.*
Voelzel, Gustave W.	*Denver, Colo.*
Walker, Stanley M.	*Denver, Colo.*
Warfel, Don	*Golden, Colo.*
Waters, Thomas E. G.	*Denver, Colo.*
Webb, Solon W.	*Battle Creek, Mich.*
Wells, Lucius C.	*Grand Junction, Colo.*
Williams, Irving B.	*Golden, Colo.*
Williams, Thomas T.	*Golden, Colo.*
University of Illinois.	
Wood, Rufus C.	*Denver, Colo.*
Iowa State College.	
University of Denver.	
Woodward, Morris H.	*Minneapolis, Minn.*
Wraith, Charles R.	*Anaconda, Mont.*
Youker, C. Norman	*Golden, Colo.*
Zwetow, Arthur N.	*Denver, Colo.*

CLASS OF 1912.

FRESHMAN CLASS.

Class Officers.

President, Frederick W. Noll.
Vice-President, William F. Dugan.
Secretary, Charles R. Hill.
Treasurer, Seymour P. Warren.

Austin, E. Clarke .... *Battle Creek, Mich.*
Baird, James R. .... *Pasadena, Calif.*
Beck, D. Llewellyn .... *Denver, Colo.*
Benner, Howard C. .... *Golden, Colo.*
Benson, Paul T. .... *Denver, Colo.*
Bicknell, Frank P. .... *Denver, Colo.*
University of Colorado
Biggerstaff, John A. .... *La Belle, Mo.*
Westminster College.
Bleil, Clarence J. .... *Golden, Colo.*
Bowhay, Arnold A., Jr. .... *Denver, Colo.*
Bowie, Howard J. .... *Cleveland, O.*
Bronstein, Charles N. .... *Denver, Colo.*
Brooke, Frederic L. .... *Los Angeles, Calif.*
Bryant, Routt A. .... *Denver, Colo.*
Buckingham, T. N. .... *Memphis, Tenn.*
Butler, John N. .... *Denver, Colo.*
A. B. St. Xavier College.
Callery, John D. .... *Pittsburg, Pa.*
Carper, Armistead F. .... *Denver, Colo.*
Cavnah, Louis G. .... *Denver, Colo.*
Claybaugh, Joseph B. .... *Fort Morgan, Colo.*
University of Iowa.
Cleland, John B. .... *Denver, Colo.*
Coman, William M. .... *Pasadena, Calif.*
Throop Polytechnic Institute.
Conrad, Barnaby .... *Seattle, Wash.*
Yale University.
Cook, Wendell P. .... *Littleton, Colo.*
University of Kansas.

Copeland, Clarence E. . . . . *Los Angeles, Calif.*

Cowperthwaite, Edward W., Jr. . . . . *Coal Creek, Colo.*

Crary, Horace H. . . . . *Canisteo, N. Y.*

Crawford, Clarence C. . . . . *Pueblo, Colo.*

Crone, H. B. . . . . *Oberlin, O.*

Curtis, Benjamin K. . . . . *Canon City, Colo.*

Curtis, Harry C. . . . . *Littleton, Colo.*

Davis, Arthur J. . . . . *Cleveland, O.*

Davis, Harold . . . . *Scranton, Pa.*

Davis, Louis L. . . . . *Kyoto, Japan*

Davis, Royal J. . . . . *Farmington, N. M.*

Desparois, Francis R. . . . . *Sioux City, Ia.*

Dittmer, Charles C. . . . . *Pueblo, Colo.*

Dugan, William F. . . . . *Minneapolis, Minn.*

University of Notre Dame.

Dunn, James L. . . . . *Minneapolis, Minn.*

Dyrenforth, Donald . . . . *Glen Ellyn, Ill.*

Edgar, Walter S. . . . . *New York, N. Y.*

Eldredge, Robert B. . . . . *Colorado Springs, Colo.*

Emrich, Jay L. . . . . *Golden, Colo.*

Erickson, Guy W. . . . . *Ouray, Colo.*

Face, Samuel A. . . . . *Norfolk, Va.*

Fay, Charles H. . . . . *Wyoming, O.*

Field, Edmund M. . . . . *Kansas City, Mo.*

Fisher, Robert E. . . . . *Omaha, Neb.*

Frazee, Verne . . . . *Moweaqua, Ill.*

Frey, Carl E. . . . . *Grand Junction, Colo.*

Gaul, John C. . . . . *Calumet, Mich.*

Michigan College of Mines.

Gillette, Leslie C. . . . . *El Paso, Tex.*

Gowen, Nelson . . . . *Victoria, B. C.*

Green, Le Roy D. . . . . *Huntington, Long Island, N. Y.*

Greensfelder, Nelson S. . . . . *St. Louis, Mo.*

Colorado College.

Grier, Charles D. . . . . *Denver, Colo.*

Gwillim, Edward C. . . . . *Colorado Springs, Colo.*

Colorado College.

Hager, Emil . . . . *Pueblo, Colo.*

Hall, Edward M. . . . . *Omaha, Neb.*

Hammen, Charles W. . . . . *Chicago, Ill.*

Harris, Arnold W. . . . . *Denver, Colo.*

Harris, Frank B. . . . . *Denver, Colo.*

Hayden, Harold P. . . . . *Beaumont, Tex.*

Herbert, John F., Jr. . . . . *Philadelphia, Pa.*

Hezmalhalch, Charles C. . . . . *Denver, Colo.*

Hill, Charles R. . . . . *New York, N. Y.*

Hoeflich, Lynn . . . . *Maysville, Ky.*

Hughes, Earl E	*Denver, Colo.*
Huntington, Walter C	*Denver, Colo.*
Jones, Chester H University of Kansas.	*Topeka, Kas.*
Jones, Lodeman E	*Denver, Colo.*
Kaanta, Henry	*Telluride, Colo.*
Kaufman, Sidney	*Denver, Colo.*
Keating, Stephen E	*Denver, Colo.*
Kennan, Ralph C	*Minturn, Colo.*
Klatt, Carl L	*Golden, Colo.*
Knapp, Benjamin F	*Canandaigua, N. Y.*
Koenig, Samuel A	*Golden, Colo.*
Kopke, Norman E	*Beaumont, Tex.*
Krier, Paul	*Walsenburg, Colo.*
Lamer, Louis C	*Los Angeles, Calif.*
Langdon, Verne R	*Chicago, Ill.*
Layne, Floyd B	*Los Angeles, Calif.*
Leland, Craig G	*Denver, Colo.*
Linn, Hugh D	*Denver, Colo.*
Lopez, Bernardo A	*Lampagos, Mexico*
Major, Finley A	*Creede, Colo.*
Manley, Edgar A	*Denver, Colo.*
Manuel, Robert A	*Los Angeles, Calif.*
Mars, Adolph D., Jr	*Spokane, Wash.*
Martin, William A	*Haxtun, Colo.*
Masten, Charles A	*Denver, Colo.*
May, Andrew J., Jr	*Tazewell, Va.*
May, Ross R	*Denver, Colo.*
McCurry, John A	*Parsons, Kas.*
McGown, Davis	*San Antonio, Tex.*
McLane, Raymond	*Cripple Creek, Colo.*
Michael, Milton H	*San Antonio, Tex.*
Moll, Claude D	*Moweaqua, Ill.*
Mott, Frederic H Purdue University.	*Hammond, Ind.*
Murphy, Joseph A	*Nampa, Ida.*
Nieman, Earl F	*Salt Lake, Utah*
Noll, Frederick W University of Chicago.	*Henry, Ill.*
Oram, Charles F	*Golden, Colo.*
Ortner, R. Earl	*Pueblo, Colo.*
Osburn, Charles M	*Golden, Colo.*
Osgood, Samuel W	*Denver, Colo.*
Pahmeyer, Harry W	*Decatur, Ill.*
Peregrine, William D	*Golden, Colo.*
Peretti, Joseph H	*Boston, Mass.*
Philips, Robert C	*Sugar City, Colo.*

Phippeny, John P..................................*Loveland, Colo.*
Phippeny, Rolfe J..................................*Loveland, Colo.*
Michigan Agricultural College.
Porter, Philip W..................................*Higgonum, Conn.*
Pratt, Allyn F..................................*Portland, Ore.*
Oregon Agricultural College.
Quick, Herbert T., Jr..................................*Golden, Colo.*
Rambo, Joseph D..................................*Norristown, Pa.*
Ramsey, Elmer R..................................*Denver, Colo.*
Raymond, Paul C..................................*Buffalo, N. Y.*
Reed, Charles H..................................*Denver, Colo.*
Richardson, Allan S..................................*Montreal, Canada*
Colorado College.
Rittmaster, Oscar..................................*Denver, Colo.*
Rohlfs, Sterling..................................*Buffalo, N. Y.*
Rusman, Ben. A..................................*Denver, Colo.*
Scott, Clarence R..................................*Idaho Springs, Colo.*
Severance, Francis E..................................*Boston, Mass.*
Shackleton, Allan D..................................*Brooklyn, N. Y.*
Sieg, Walter J..................................*Golden, Colo.*
Slattery, Frank E..................................*Silverton, Colo.*
Smith, Charles L..................................*Golden, Colo.*
Smith, Edward H..................................*Boston, Mass.*
Solomon, Irwin R..................................*St. Louis, Mo.*
Sprague, Ross C..................................*Denver, Colo.*
Stearns, Evans F..................................*Wyoming, O.*
Stewart, Allister K., Jr..................................*St. Louis, Mo.*
Stewart, Hugh A..................................*Cripple Creek, Colo.*
Swan, Walter H..................................*Denver, Colo.*
Swenson, Howard H..................................*Denver, Colo.*
Missouri School of Mines.
Tarbell, Hallie H..................................*Denver, Colo.*
Thomas, Lester C..................................*Denver, Colo.*
Thompson, R. V..................................*Los Angeles, Calif.*
Thurstin, Robert A..................................*Bowling Green, O.*
Kenyon College.
Toenges, Albert L..................................*Dayton, O.*
Trounce, Henry D..................................*Truro, Cornwall, England*
Tweeddale, Thomas W..................................*Golden, Colo.*
Van Ullem, Nelson R..................................*Lakewood, Colo.*
Virgil, Willis E..................................*Kalamath Falls, Ore.*
Waldman, Philip..................................*Chicago, Ill.*
Lewis Institute.
Walker, Alexander D..................................*Cripple Creek, Colo.*
Warren, Seymour P..................................*Denver, Colo.*
Watkins, Harold A..................................*Golden, Colo.*
University of Colorado.

Watson, Samuel E.	*Clarksville, Tex.*
Weeks, George W., Jr.	*Canton, O.*
Weller, Simon T.	*Denver, Colo.*
Weymouth, C. E.	*Amarillo, Tex.*
Westminster College.	
Wheatley, Paul V.	*Spokane, Wash.*
Gonzaga College.	
Wheelock, Harold F.	*Denver, Colo.*
Whitehead, Paul.	*Denver, Colo.*
Wigton, George H.	*Denver, Colo.*
Wilcoxson, Edward D.	*Pueblo, Colo.*
Wood, Edwin C.	*Denver, Colo.*
Iowa College.	
Woodard, George C.	*St. Joseph, Mo.*
Woodbury, Joseph F.	*Greeley, Colo.*
Woodward, Delbert H.	*Warren, O.*
Woolf, Joseph, Jr.	*Greeley, Colo.*
Wright, Thomas W.	*Golden, Colo.*
Zulch, William G.	*Denver, Colo.*

SUMMARY.

Postgraduates	29
Seniors	43
Juniors	70
Sophomores	86
Freshmen	166
	394
Counted twice	27
Total	367

ALUMNI.

Abel, Walter D., '06.....................*Box 110, Rawhide, Nev.*
Adami, Charles J., '99...........................*Flat River, Mo.*
    Mining Superintendent, Federal Lead Co.
Adams, Charles, '04.............................*Rhyolite, Nev.*
    Montgomery Shoshone Mines Co.
Adams, Wilber E., '00...........................*Lewiston, Ida.*
    Mining Engineer and U. S. Mineral Surveyor.
Aldrich, Harold W., '06.............*420 Main St., Anaconda, Mont.*
    Testing Department, Anaconda Smelter.
Allen, Carl A., '05..................*614 Ideal Bldg., Denver, Colo.*
    Allen and Colburn, Mining Engineers.
Allen, Maynard C., '06............................*Basin, Mont.*
    Montana Consolidated Mining Co.
Aller, Frank D., '92...*Caseilla 35, Antofagasta, Chili, South America*
Ambrosius, Carl E., '88...............*Guanacevi, Durango, Mexico*
Anderson, Axel E., '04......................... *Wilmington, Del.*
    E. P. Du Pont de Nemours Powder Co.
Anderson, Neil A., '02...
Armington, H. C., '07...........................*Leadville, Colo.*
    Western Mining Company.
Arthur, Edward P., '95..*Care Bimetallic Bank, Cripple Creek, Colo.*
    U. S. Mineral Surveyor.
Atkins, Horace H., Jr., '94...................................
Atkinson, Walter J., '96......................................
Atwater, Maxwell W., '01..............*Magdalena, Sonora, Mexico*
    Black Mountain Mining Co.
Austin, Arthur, '05..............*708 Locust St., Anaconda, Mont.*
    Washoe Smelter, Anaconda Copper M. Co.
Badger, Herbert E., '02................*920 9th Ave., Greeley, Colo.*
Badgley, Charles W., '06...........*1730 Franklin St., Denver, Colo.*
    Assistant Chemist, A. S. & R. Co.
Bailey, E. W., '05..............*309 McPhee Building, Denver, Colo.*
Ball, Max W., '06.............................*Washington, D. C.*
    U. S. Geological Survey.
Barbour, Percy P., '98.......................*Idaho Springs, Colo.*
    Stevens, Barbour & Co., Mining Engineers.
Barensheer, William J., '96...................................
Barker, Franklin L., '06............................*Eugene, Ore.*
    Professor of Mining, University of Oregon.
Barker, Pierce, '07...........................*Anaconda, Mont.*
    Amalgamated Copper Co.
Barnes, Corrin, '96...........................*Goldfield, Nev.*

Barron, Chauncey T., '02.......*Aire Libre, Estado de Puebla, Mexico*
Teziutlan Copper Co., Puebla, Mexico.

Bartholomew, Tracy, '06..............................*McGill, Nev.*
Steptoe Valley S. & M. Co.

Bastanchury, G. A., '07..........................*New York, N. Y.*
Graduate School, Columbia University.

Beeler, Henry C., '96..................*State Capitol, Cheyenne, Wyo.*
State Geologist of Wyoming.

Bell, Charles N., '06..................................*Ouray, Colo.*
Care Ingersoll and Bell, Mining Engineers.

Bellam, Henry L., '89..............................*St. Clair, Nev.*
Assistant Engineer, U. S. Reclamation Service.

Benwell, George A., Jr., '00........*1337 Josephine St., Denver, Colo.*
Mining Engineer.

Bergh, John E., '02...............................*Bingham, Utah*
Engineer, Bingham Consolidated M. & S. Co.

Berry, Albert, '05..................*3221 First Ave., Spokane, Wash.*

Bertschy, Perry H., '98..........................*Deadwood, S. D.*

Bishop, Raymond, '01..
Deceased.

Blackburn, Ward W., '08............................*Denver, Colo.*

Block, Gary E., '08...................................*Jerome, Ariz.*
United Verde Copper Co.

Blumenthal, Emil E., '98.........................*Phillipsburg, Mont.*
Granite Bimetallic Mining Co.

Bowie, James W., '94..
Deceased.

Bowman, Frank C., '01..............................*Telluride, Colo.*
Superintendent, Japan Flora Mines & Tunnel Co

Boyd, Jesse T., '08...................................*Ouray, Colo.*
Camp Bird Mines.

Bradley, Joseph M., '01..............................*Austin, Nev.*

Brandt, A. R., '07......................*820 Elati St., Denver, Colo.*

Breed, Charles F., '01..

Brinker, Arthur C., '01..............................*Ouray, Colo.*
Metallurgist. Camp Bird Mine.

Brinker, Albert W., '08..
Deceased.

Brown, Leroy C., '08..............................*Gladstone, Colo.*
Assistant Superintendent of Mill, Gold King Consolidated M. Co.

Brown, John B., '06...*Casa Grande, Real del Monte, Hidalgo, Mexico*

Brown, Norton H., '92.........................*Idaho Springs, Colo.*
U. S. Mineral Surveyor.

Brown, R. L., '05...........................*Box "O", Auburn, Ala.*
Professor of Mining and Geology, Alabama Polytechnic Institute.

Bruce, Harry F., '00...............................*Tonopah, Nev.*
Electro Geodetic Mining Co.

Bruce, James L., '01...........................*Box 83, Joplin, Mo.*
Assistant Superintendent, Grace Zinc Mining Co.

Bruce, Stewart S., '99.......................*Salt Lake City, Utah*
A. S. & R. Co.

Brunel, Rene L., '06........................*Box 839, Goldfield, Nev.*

Bryan, Russell R., '08..............................*Anaconda, Mont.*
New Reduction Works, Anaconda Copper M. Co.

Bucher, John W., '02............*106 W. Ramsey St., Goldfield, Nev.*
Care Cox & Bucher, Mining Engineers.

Buck, Arthur H., '97..............................*Denver, Colo.*

Budrow, William B., '92...

Buell, Arthur W., '08..................................
..*The Newberry Club, Box 336, Guayaquil, Ecuador, So. Amer.*
South American Development Co.

Bumsted, Edward J., '01..................*Taviche, Oaxaca, Mexico*
Manager, Tehauntepec Silver Mines Co.

Burlingame, Walter E., '01................*Box 1520, Denver, Colo.*
Chemist and Assayer.

Busey, A. P., Jr., '05.........*Campo Seco, Calaveras Co., California*
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Bussey, Edwin E., '97.......*136 Florissant St., Cripple Creek, Colo.*

Butler, G. Montague, '02...........................*Golden, Colo.*
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Canning, Herbert A., '97.........................*Flat River, Mo.*
Assistant Superintendent, Federal Lead Co.

Carney, Hugh J., '04...............................*Ouray, Colo.*

Carstarphen, F. C., '05............*517 Ideal Building, Denver, Colo.*

Chamberlin, W. O., '05.................*200 Pearl St., Denver, Colo.*

Chandler, John W., Jr., '01.........................*Tonopah, Nev.*
Nevada Garfield Consolidated Mining Co.

Chapman, Thomas L., '06..........................*Goldfield, Nev.*

Charles, Lavern J., '02........*14 South 8th St., No. Yakima, Wash.*
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Chedsey, William R., '08..........................*Moscow, Ida.*
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Christensen, Walter, '02...

Church, Myron J., '98................*267 6th St., Milwaukee, Wis.*
Davis Manufacturing Co.

Clark, George B., '01............*1514 S. Emerson St., Denver, Colo.*

Clark, Winfred N., '98.............................*Victor, Colo.*
Superintendent, Pueblo and Suburban Traction and Lighting Co.

Cline, Seymour F., '08.............*116 Vennum Ave., Mansfield, O.*

Coghill, Will H., '03...............................*Evanston, Ill.*
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Cohen, Louis, '97...............*417 Jackson Building, Denver, Colo.*
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Colburn, C. L., '07................*614 Ideal Building, Denver, Colo.*
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Cole, Burt, '92..................................*Tecumseh, Ala.*
Superintendent, Tecumseh Iron Co.

Coleman, R. Prewitt, '03..*510 McCornick Bldg., Salt Lake City, Utah*
Mining Engineer.

Collbran, Arthur H., '02.......................*Pyeng Yang, Korea*
Manager, Suan Mine.

Collins, Phililp M., '93 .... *424 College Ave., Canon City, Colo.*
U. S. S. Co.

Collins, Shrive B., '01 .... *Amethyst P. O., Creede, Colo.*
Mining Engineer.

Comstock, Charles W., '90 .... *213 Boston Building, Denver, Colo.*

Corson, N. G., '07 .... *Box 282, Rawhide, Colo.*

Cory, J. J., '05 .... *Ellamar, Alaska*
Mining Engineer, Ellamar Mining Co.

Corry, Arthur V., '98 .... *23 Silver Bow Block, Butte, Mont.*

Cox, Augustus D., '03 .... *Box 1262, Goldfield, Nev.*

Cox, W. Ray, '02 .... *R. F. D. No. 1, Box 24, Ault, Colo.*

Craigue, William H., '89 .... *Rhyolite, Nev.*

Cramer, Curtis P., '99 .... *Fierro, N. M.*
Superintendent Emma Mine, Copper Queen Consolidated Mining Co.

Crowe, Thomas B., '00 ....

Crow, Wade L., '01 ....
Deceased.

Cuno, A. F., '05 .... *1538 E. 32d Ave., Denver, Colo.*

D'Arcy, R. L., '05 .... *126 Logan Ave., Denver, Colo.*

Davey, William R., Jr., '98 .... *Lake City, Colo.*
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Davis, Carl R., '95 ....

Davis, Gilbert L., '99 .... *Flat River, Mo.*
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De Camp, W. Val, '08 .... *Ouray, Colo.*
Atlas Mine.

De Cou, Ralph E., '01 .... *Ouray, Colo.*
Camp Bird Mill.

De Sollar, Tenney C., '04 .... *Box 45, Hancock, Mich.*
Mining Engineer, Quincy Mining Co.

Devinney, George V., '03 ....
Deceased.

Dilts, Ira J., '08 .... *Concrete, Colo.*
Chemist, Portland Cement Co.

Dockery, L. A., '95 .... *Chihuahua, Mexico*
Mining Engineer.

Dollison, James E., '98 .... *Alma, Colo.*
Surveyor, and Proprietor Alma Assay Office.

Dow, William G., '06 .... *Scott's Bluff, Neb.*
U. S. Reclamation Service.

Downer, Roger H., '01 .... *Box 175, Goldfield, Nev.*

Draper, Marshall D., '97 .... *Central City, Colo.*
General Superintendent, Fifty Gold Mines Co.

Drescher, Frank M., '00 .... *Prescott, Ariz.*
Care Elliott and Drescher, Mining Engineers.

Duer, C. L., '05 .... *Box 95, Boulder, Colo.*
Wilson and Fair, Civil and Mining Engineers.

Dunkle, Fred W., '03 .... *Ouray, Colo.*
Chief Engineer, Camp Bird Mine.

Dunlevy, Forrest S., '08 .... *1821 E. 31st St., Denver, Colo.*

Durell, Charles T., '95. . . . .
Dwelle, Jesse E., '96. . . . . *2244 Gaylord St., Denver, Colo.*
Venture Corporation, Ltd.
Eames, L. B., '05. . . . . *Terry, S. Dak.*
Eaton, Albert L., '95. . . . . *Chihuahua, Mexico*
Assistant Superintendent, Chihuahua Mining Co.
Ehle, Mark, Jr., '01. . . . . *Rapid City, S. Dak.*
Professor of Mining, South Dakota School of Mines.
Ehrich, Walter L., '02. . . . .
Elder, Robert B., '08. . . . . *Green River, Wyo.*
Western Alkali Co.
Ellis, T. P., '07. . . . . *Denver, Colo.*
Board of Public Works.
Ellis, William W., '02. . . . . *535 17th St., Denver, Colo.*
Ellsworth, Alfred C., '08. . . . . *Alder, Colo.*
Superintendent, Chicago Consolidated Gold and Silver M. & M. Co.
Emeis, Walter A., '04. . . . . *Platteville, Wis.*
Emens, Ray B., '07. . . . . *Octave, Ariz.*
Emrich, Horace H., '03. . . . . *Maurer, N. J.*
Assistant Superintendent, P. A. Plant, A. S. & R. Co.
Estes, Frank M., Jr., '02. . . . . . . *907 Carleton Building, St. Louis, Mo.*
Evans, Henry R., '00. . . . . *Armington, Mont.*
Great Northern Railway.
Evans, Willis, W., '08. *Box 329, Leadville, Colo.*
Assistant Engineer, Yak Mining, Milling & Tunnel Co.
Everest, Herbert A., '08. . . . . . . *511 E. 10th St., Oklahoma City, Okla.*
Ewing, Charles R., '00. . . . . *Del Norte, Colo.*
Eye, Clyde M., '95. . . . . *Baquio, Province of Bengeret, P. I.*
Febles, John C., '97. . . . . *Box 105, Butte, Mont.*
Chemist, Anaconda Copper Co.
Field, Fred M., '95. . . . . *Beatty, Nev.*
Metallurgist, Consolidated Montgomery Shoshone Mines Co.
Fillius, Lee L., '04. . . . . *Telluride, Colo.*
Cyanide Department, Smuggler Union Co.
Filteau, C. A., '07. . . . . *Telluride, Colo.*
Japan-Flora Mines & Tunnel Co.
Finigan, William H., '06. . . . . *4137 Lindell Boulevard, St. Louis, Mo.*
Fleming, William L., '03. . . . .
Flint F. F., '05. . . . . *R. F. D. No. 4. Greeley, Colo.*
Floyd, John A., '88. . . . .
Deceased.
Ford, Homer D., '05. . . . . *Howardsville, Colo.*
Care Old Hundred Mine.
Foster, George C., '03. . . . . *2106 E. 17th Ave., Denver, Colo.*
Franck, Albert C., '04. . . . . *3035 Flora Ave., Kansas City, Mo.*
Franck, Robert P., '04. . . . .
Frank, Harry L., '01. . . . . *Box 1436, Denver, Colo.*
Frank, Morton E., '06. . . . . *4516 Drexel Boulevard, Chicago, Ill.*
Freeland, William H., '06. . . . . . *3024 Lowell Boulevard, Denver, Colo.*

French, Burr J., '08 .... *Canclas, Durango, Mexico*
French, Sidney W., '08 .... *Golden, Colo.*
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Funk, Walter A., '03 .... *Central City, Colo.*
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Gardner, John I., '06 .... *Idaho Springs, Colo.*
Garza, Adalpe J. M., '05 .... *Box 225, Torreon, Soahuila, Mexico*
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Gehrmann, Charles A., '86 ....
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Giddings, Donald S., '00 .... *722 10th St., Colorado Springs, Colo.*
Portland Gold Mining Co.
Gilbert, Arthur K., '06 .... *Walsenburg, Colo.*
Assistant Engineer, C. F. & I. Co.
Gilbert, William J., '06 .... *Masonic, Calif.*
Goe, Harold H., '08 .... *320 W. 4th St., Anaconda, Mont.*
New Reduction Works, Anaconda Copper Mining Co.
Golden, J. P., '07 .... *Cheyenne, Wyo.*
U. S. General Land Office.
Goodale, Stephen L., '04 .... *Pioche, Nev.*
Assistant Superintendent, The Bristol Consolidated M. & S. Co.
Gordon, John G., Jr., '06 .... *Elliston, Mont.*
Jericho Mountain Copper Co.
Gow, P. A., '07 .... *Butte, Mont.*
Amalgamated Copper Co.
Grant, Lester S., '99 .... *Tirapato, via Juliaco, Peru, South America*
Engineer, Inca Mining Co.
Gray, Latimer D., '95 .... *Rock Springs, Wyo.*
Manager, Electric Department, U. P. Coal Co.
Greve, E. E., '05 .... *492 First St., Brooklyn, N. Y.*
Grider, R. L., '05 .... *Seiad Valley, Calif.*
Griswold, George G., '96 .... *Box 312, Leadville, Colo.*
Grommon, P. D., '07 .... *Denver, Colo.*
Colorado Iron Works.
Gross, John, '97 .... *417 Jackson Building, Denver, Colo.*
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Care Von Schulz and Low, Assayers.
Hallett, W. J., '05 .... *Rock Springs, Wyo.*
Care U. P. Coal Co.
Hamilton, Frank R., '98 .... *Watsonville, Calif.*
Harkison, Charles W., '06 .... *Box 161, Hailey, Ida.*
Bannock Engineering Co., Ltd.
Harrington, Daniel, '00 .... *27 H St., Salt Lake City, Utah*
Harrington, Orville, '98 .... *1485 S. University St., Denver, Colo.*
U. S. Mint.

Harris, Morrison, '08............................*Newhouse, Utah*
Cactus Mine.
Harris, Willard F., '01........................*Sudi Dgo., Mexico*
Manager, Sudi Au Mining Co.
Harrison, Thomas S., '08.........................*Cheyenne, Wyo.*
Field Division, U. S. General Land Office.
Hartzell, Lester J., '95.............................*Butte, Mont.*
Assistant Professor of Chemistry, Montana School of Mines.
Hawley, R. Howard, '93..
Hazard, William J., '97............................*Golden, Colo.*
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Heitz, George H., '06....................*Box 526, Leadville, Colo.*
Surveyor.
Hensley, James H., '06.............................*Bishop, Calif.*
Nevada-California Power Co.
Hewitt, A. F., '05...................*2143 Grove St., Denver, Colo.*
Mining and Construction Engineer.
Hill, Frank C., '04.......................*Winter Quarters, Utah*
Hills, Leon P., '08...............................*Silverton, Colo.*
Hindry, Willis E., '92............*El Oro, Estado de Mexico, Mexico*
Manager, Esperanza Mining Co.
Hodgson, Arthur, '99..............................*Denver, Colo.*
Assayer, U. S. Mint.
Hollis, D. D., '07...................................*Victor, Colo.*
Taylor and Brunton Sampling Co.
Hornbein, Julius, '05..............*2351 Clarkson St., Denver, Colo.*
Howat A. M., '07...........................*Mammoth, Calif.*
Mammoth Copper Mining Co.
Hoyt, George F., '96...
Hunt, T. R., '05...............................*Keswick, Calif.*
Iron Mountain Copper Co.
Hyder, C. A., '05.....................*Moctezuma, Sonora, Mexico*
Care Hyder & Hyder, Mining Engineers.
Hyder, Frederick B., '03..............*Moctezuma, Sonora, Mexico*
Care Hyder & Hyder, Mining Engineers.
Ickis, Harry M., '02..
Deceased.
Ingersoll, Julius C., Jr., '06.........................*Ouray, Colo.*
Care Ingersoll & Bell, Mining Engineers.
Ingols, J. August, '98.............................*Milford, Utah*
General Superintendent, Majestic Copper M. & S. Co.
Ireland, Carrol B., '08..........................*Georgetown, Colo.*
Superintendent, Atlantic M. & M. Co.
Isom, E. W., '07........................*Dawson, Yukon Territory*
Yukon Consolidated Gold Fields Co.
Izett, Glenn, '03..........................*Box 22, Littleton, Colo.*
Denver Union Water Co.
Jackson, Walter H., '01............*Mapimi, Ojuela, Durango, Mex.*
Mining Engineer, Compania Minera de Penoles.
Jacques, Henry L., '08.............*487 Canosa Court, Denver, Colo.*

Jarvis, Royal P., '97............................*Knoxville, Tenn.*
Professor of Mining and Metallurgy, University of Tennessee.
Jewel, Gilbert E., '93...
Johnson, Byron M., '08............................*Denver, Colo.*
Johnson, Edward W., '91.....................*Salt Lake City, Utah*
Superintendent, Garfield Smelting Co.
Johnson, Gilbert, Jr...
Deceased.
Johnson, Junius W., '01,.......*Apartado 1583, Mexico City, Mexico*
Johnson and Enos, Mining Engineers.
Johnson, Lafayette G., '04..........................*Flat River, Mo.*
Engineer, Federal Lead Co.
Johnston, Fred, '98..............................*Leadville, Colo.*
Assistant Superintendent, Arkansas Valley Plant, A. S. & R. Co.
Jones, Edward B., '00.....*326-27 Dooly Block, Salt Lake City, Utah*
Jones, Frank H., '98................................*McGill, Nev.*
Steptoe Valley S. & M. Co.
Jones, Fred, '00....................................*Victor, Colo.*
Engineer, Portland G. M. Co.
Jones, I. Percy, '08.................................*Victor, Colo.*
Taylor and Brunton Sampling Co.
Jones, W. Ashby, '08..............................*Ware Neck, Va.*
Jones, Mrs. F. H., '98..............................*McGill, Nev.*
Kell, Wayne S., '06.................................*Atlanta, Ga.*
Professor of Mining, Georgia School of Technology.
Kelley, Fred G., '99...
Kelly, William A., '97..............................*Big Bug, Ariz.*
Superintendent, Henrietta Mines and Mills.
Kennedy, George A., '95.......*719 E. and C. Building, Denver, Colo.*
Mining Engineer, Venture Corporation of London.
Kenner, A. R., '07...................*1824 Curtis St., Denver, Colo.*
Care The Mining and Metallurgical Journal.
Kilbourn, William D., '04..........................*Murray, Utah*
Murray Plant, A. S. & R. Co.
Kilgour, M. Hamilton, '08.... *16 Exchange Place, New York, N. Y.*
Care Canadian Bank of Commerce.
Kimball, George K., '92.......................*Idaho Springs, Colo.*
General Manager, Old Town Mining Co.
Kimball, Harlow M., '04.................................
......*13-15 Hooper and Eldredge Block, Salt Lake City, Utah*
Care R. K. A. Kletting.
Kimball, Joseph S., '92.......................*Russell Gulch, Colo.*
King, Henry E., '03.......*419 E. Kiowa St., Colorado Springs, Colo.*
Assistant City Engineer.
Kingman, Jerry, '88..
Deceased.
Kleff, J. Marvin, '06.....................*Box 804, Leadville, Colo.*
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Mining Engineer.
Knight, Hal G., '08....................*129 S. Union St., Akron, O.*

Knight, R. E., '07................................*Terlingua, Tex.*
Care Chisos Mining Co.
Knowles, Benjamin W., '08........................*Dunton, Colo.*
Assistant Superintendent, Emma Mine.
Kraemer, Edward L., '98..........................*Bingham, Utah*
Yampa Smelting Co.
Krueger, G. S., '07..............................*Bingham, Utah*
Boston Consolidated Mining Co.
Langrall, Charles A., '08..............................*Ray, Ariz.*
Lampe, Oscar A., '98...........*Apart. 55, Guanajuato, Gto. Mexico*
Superintendent, Cyanide Plant, Guanajuato Reduction and Mines Co.
Lannon, F. P., Jr., '07............................*Leadville, Colo.*
Superintendent, Adams Mill.
Larison, E. L., '05................................*Isabella, Tenn.*
Care D. S. C. & I. Co.
Larsh, Walter S., '04..................................*Ely, Nev.*
Assistant Superintendent, Cumberland Ely Copper Co.
Lee, Robert P., '05...........................*Box 53, Ely, Nev.*
Lee, Wallace, '04............................*Ures, Sonora, Mexico*
Care Wendler and Lee, Mining Engineers.
Lehmer, Frank W., '02.....................*Ocotlan, Oaxaca, Mexico*
Manager, Compania Minera Zapoteca.
Lemke, Carl '00..
Lennox, L. W., '05.................................*Victor, Colo.*
Strong G. M. Co.
Lerchen, F. H., '97.........................*Box 175, Deming, N. M.*
Lima Lead Co.
Lesher, Carl E., '08..............................*Nelson, B. C.*
Canada Zinc Co.
Levy, Archibald L., '06..............*3238 Vernon Ave., Chicago, Ill.*
Lewis, Alfred S., '05..............................*Hatchita, N. M.*
Care Red Hills Mines Co.
Lewis, Frank E., '01..............................*Smuggler, Colo.*
Care Tom Boy Mine.
Lewis, William B., '92.........*204 Coronado Building, Denver, Colo.*
General Manager, South Canon Coal Co.
Libby, James L., '06..........................*Rock Springs, Wyo.*
Assistant Engineer, Union Pacific Coal Co.
Liddell, T. Parker, '03......................*Battle Mountain, Nev.*
Liddell, Charles A., '03.........................*Manhattan, Nev.*
Limbach, Edmund C., '95.......*64 Starr-Boyd Bldg., Seattle, Wash.*
Link, Karl G., '08..................*1641 Gaylord St., Denver, Colo.*
Logue, N. W., '97..
Lonergan, P. Jay, Jr., '05.......................*Greenwater, Calif.*
U. S. Mineral Surveyor.
Lorah, Bela J., '88..
Deceased.
Lovering, Ira G., '01..............*Apart. 21, Sabinas, Coah., Mexico*
Lowell, James B., '08............................*Worcester, Mass.*

Lucy, Frank A., '01.............................*Goldfield, Nev.*
Mining Engineer.
Lucy, Richard W., '98..........*Room 5, Union Depot, Pueblo, Colo.*
D. & R. G. Ry.
McDaniel, Alexander K., '01.........*111 W. 4th Ave., Denver, Colo.*
Mining Engineer.
McCart, Robert, '05.............................*Silverton, Colo.*
Assistant Superintendent, Silver Lake Mines.
McDermutt, Grace C. U., '03..............................
..............*1314 Wallach Place, N. W., Washington, D. C.*
Bureau of Standards.
McElvenny, Robert F., '03...................................
McLeod, J. Norman, '97...........*1734 Glenarm St., Denver, Colo.*
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Mine Superintendent, A. S. & R. Co.
MacGregor, George H., '97........*719 Equitable Bldg., Denver, Colo.*
Engineer, Industries Co.
Magenau, William, '98....*Apart. 30, Gomez Palacio, Durango, Mex.*
Malmstrom, C. Clarence, '00........*1109 E. 13th Ave., Denver, Colo.*
Assayer, Denver Mint.
Marrs, George O., '01.................*1632 York St., Denver, Colo.*
Martin, J. A., '07...................*Box 1006, Cripple Creek, Colo.*
Maxwell, Fred A. G., '95......*Randfontein, Transvaal, South Africa*
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May, John G., '01......................*Oxford Hotel, Denver, Colo.*
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Medell, William S., '95.............................*Golden, Colo.*
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Merryman, Herbert E., '95.......................*Enterprise, Ore.*
U. S. Mineral Surveyor.
Merwin, Eugene W., '03.........*510 Grant Bldg., Los Angeles, Calif.*
Middelkamp, L. L., '05..........................*Ellamar, Alaska*
Middleton, William B., '83..................................
Millard, Frank W., '01...............................*Ely, Nev.*
Mining Engineer.
Milliken, John T., '96......................*Colorado Springs, Colo.*
Superintendent, Golden Cycle Mill.
Milliken, William B., '93.........*1407 Josephine St., Denver, Colo.*
Mitchell, George B., '96..........................*Montreal, Canada*
Engineers Club.
Montrose, James F., '02............*1549 St. Paul St., Denver, Colo.*
Moore, C. F., '07...
Deceased.
Moore, G. P., '07..................*135 W. 8th St., Leadville, Colo.*
Moss, Cleveland O., '02.......*901 Security Bldg., Los Angeles, Calif.*
Consulting Mining Engineer.
Moynahan, Ambrose E., '00...........................*Alma, Colo.*
Assayer and Mining Engineer.
Muir, David, '99..............................*Yaalpom, Calif.*

Muir, Douglas, '05..................*Tepelmanes, Durango, Mexico*
Superintendent, El Conde M. Co.
Murch, Clarence H., '08............................*Ouray, Colo.*
Camp Bird Mine.
Nagel, Frank J., '03..............................*Goldfield, Nev.*
Nagel, Henry P., Jr......................*Ojuela, Durango, Mexico*
Nance, William H., '96......................*Box 178, Salida, Colo.*
Assayer, Ohio and Colorado Smelter.
Nelson, H. E., '97..................................*Victor, Colo.*
Superintendent of Mill, Stratton's Independence L. & A.
Neugebauer, Karl E., '06.............*Terrazas, Chihuahua, Mexico*
Neville, J. B., Jr., '05..
Newman, William E., '96.............*Matehuala, S. L. P., Mexico*
Superintendent, Cia Metallurgica Nacional.
Nicholson, George W., '00..................*Box 31, Mojave, Calif.*
Queen Esther Mining Co.
Norman, John E., '98......*302 Mining Exchange Bldg., Denver, Colo.*
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Nyberg, H. Edward, '06................*Teziutlan, Puebla, Mexico*
Teziutlan Copper Co.
Nye, Robert, '97..
O'Byrne, Joseph F., '05...........................*Contact, Nev.*
Care Fairbanks and O'Byrne, Mining Engineers.
Osborne, Arthur H., '93........................*Georgetown, Colo.*
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Page, Lawrence C., '08..................*22 Bank St., Norfolk, Va.*
Palsgrove, Harry G., '03............*Cuatro Cienagas, Coah., Mexico*
Care Mina Reforma.
Paredes, Evaristo, Jr., '05..................*Cosala, Sinaloa, Mexico*
General Manager, La Prieta M. Co.
Parker, James H., '95......*13 and 14 Masonic Temple, El Paso, Tex.*
Parks, George A., '06.............*3347 Boulevard F, Denver, Colo.*
Parrish, Carl C., '01.....................................*Leon, Ia.*
Mining Engineer.
Parsons, F. H., '07............................*Bingham, Utah*
Boston Consolidated Mining Co
Parsons, Horace F., '03..
Patterson, S. B., Jr., '06......................*Majari, Oriente, Cuba*
Spanish-American Iron Co.
Paul, Russell B., '02...............................*Littleton, Colo.*
Paul, William H., '96.................*Madera, Chihuahua, Mexico*
Manager, Dolores Mines Co.
Pendery, John M., '00..............*136 W. 7th St., Leadville, Colo.*
Yal Tunnel M. & M. Co.
Pfeiffer, G. N., '05...............*Asientos, Aguas Calientes, Mexico*
A. S. & R. Co.
Phelps, W. B., '07............................*Los Angeles, Calif.*
Care Pacific Crockery and Tinware Co.
Pilger, Newton W., '06...........*626 Hennessey Bldg., Butte Mont.*
Anaconda Copper Mining Co.

Platt, Edwin H., '00................*434 Cooper Bldg., Denver, Colo.*
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Post, George M., '94...................*2928 Hale St., Denver, Colo.*
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Powell, George F., '97.................*Hermacillo, Sonora, Mexico*
Manager, Tajo Mining Co.
Powers, Oliver, '02............................*Oakland, Calif.*
Pray, Milton A., '08............................*Wadsworth, Nev.*
Pray, Winfred A., '01......................*Box 426, Fernley, Nev.*
Pressler, L. P., '05...............................*Goldfield, Nev.*
Price, Lyttleton, Jr., '00......*228 Dooly Blk., Salt Lake City, Utah*
Prier, Truman D., '04...............................*Ruby, Mont.*
Engineer, Courey Mining Co.
Prout, John, '00...................................*Golden, Colo.*
Putnam, George B., '05.........*Pilares de Nacozari, Sonora, Mexico*
Moctezuma Copper Co.
Quayle, T. W., '07...............................*Terlingua, Tex.*
Care Chisos Mining Co.
Rabb, E. M., '05..................*3533 W. 24th Ave., Denver, Colo.*
Rath, C. M., '05................*2017 Pebrican St., Cheyenne, Wyo.*
U. S. Federal Land Office.
Reinhard, Frank J., '05........................*Atlantic City, Wyo.*
Superintendent, Pay Rock Co.
Reno, Charles F. A., '08...*19 E. Willamette St., Colorado Springs, Colo.*
Reno, Horace T., '02..............................*Goldfield, Nev.*
Rhodes, William B., '03..................*Rosario, Sinaloa, Mexico*
Mines Del Tajo.
Rich, James U. G., '08..........................*Nashville, Tenn.*
Richards, E. R., '05...............................*Lincoln, Calif.*
Richards, John V., '02...........................*Spokane, Wash.*
Mining Engineer, with Finch and Campbell.
Ripley, George C., '06............................*Mojave, Calif.*
Los Angeles Aqueduct.
Rising, Arthur F., '99......................................
Deceased.
Robey, Loyd, '00........................*Gabriel, Durango, Mexico*
San Luis Mining Co.
Robinson, George P., '04...................*Aguas Calientes, Mexico*
Care A. S. & R. Co.
Rodriguez, J. C., '98......................*City of Mexico, Mexico*
Mining Engineer.
Roller, Arthur H., '97........................*Idaho Springs, Colo.*
Manager, Shafter Mining Co., and Hudson Reduction Co.
Root, Charles D., '08..............................*Bingham, Utah*
Utah Consolidated Mining Co.
Ross, G. M., '07...................................*Vernon, Colo.*
Rowe, Charles E., '02...............................*Austin, Tex.*
Professor of Mining, University of Texas.
Rowe, Edward E., '95..............*1250 Boulevard F, Denver, Colo.*
Manager, E. E. Rowe & Co.
Royer, Frank W., '99..............*4003 W. 35th Ave., Denver, Colo.*

Rudd, Arthur H., '00 .... *Enterprise, Ore.*
Ryan, W. E., '05 .... *Hazleton, B. C.*
Saint Dizier, Julius L., '94 .... *Santa Rosalia, Chihuahua, Mexico*
    Superintendent, Encinillas Smelting Co.
Sale, Andrew J., '01 .... *Kimberly, Nev.*
    Mining Engineer, Giroux Consolidated Mines Co.
Sandusky, Samuel C., '08 .... *Salida, Colo.*
Scheble, Max C., '01 .... *Agujita via Sabinas, Coah., Mexico*
Schlereth, C. Quinby, '06 .... *Ojuela, Durango, Mexico*
    Compania Minera de Penoles.
Schneider, George W., '94 .... *136 Logan Ave., Denver, Colo.*
    Mining Engineer
Schumann, Enrique A., '97 ....
Shaver, F. J., '07 .... *Victor, Colo.*
    Portland Gold Mining Co.
Sherman, Scott H., '04 .... *Christmas, Ariz.*
    Saddle Mountain Mining Co.
Shetler, Waverly, '95 ....
    Deceased.
Sill, Rush T., '06 .... *Hibbing, Minn.*
    Geological and Mining Department, Great Northern Railroad.
Simpson, William P., '01 .... *Monterey, N. L., Mexico*
    Cia de Minerales y Metales.
Skinner, Lewis B., '95 .... *Denver, Colo.*
    Chemist and Metallurgist, Western Chemical Mfg. Co.
Slater, Amos, '00 .... *Tacoma, Wash.*
    Geologist, Northern Pacific Ry.
Sloan, W. Arthur, '03 .... *Clifton, Ariz.*
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    Care A. Stegman.
Smith, C. Dupree, '91 .... *Newton, Ia.*
    Consulting Mining and Metallurgical Engineer.
Smith, Claude H., '00 ....
    Deceased.
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    El Tiro Copper Co.
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    City Building Inspector.
Stannard, Burt C., '95 .... *Everett, Wash.*
    Chemist, Puget Sound Reclamation Service.
Starbird, Edwin P., '01 ....
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    General Superintendent, Security Reduction Co.
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    Instructor in Mathematics and Drafting, Manual Training High School.

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Assistant Engineer, Board of Public Works.

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Board of Public Works.

Stephens, Wallace A., '93.........*1734 Arapahoe St., Denver, Colo.*
Consulting Mining and Metallurgical Engineer with Henry E. Wood & Co.

Stephenson, Tiffany E., '06.....................*Fort Morgan, Colo.*

Stockton, Robert S., '95..........................*Huntley, Mont.*
U. S. Reclamation Service.

Stoeckley, E. F., '06...........................*Greenwater, Calif.*
U. S. Mineral Surveyor.

Storm, Lynn W., '02...

Stotesbury, H. W., '07...........................*Tonopah, Nev.*
Chief Engineer, Tonopah Mining Co.

Street, Gerald B., '01........*Morman Basin, via Rye Valley, Ore.*
Commercial Mining Co.

Strout, Fred McL., '96.........................*Deadwood, S. Dak.*
General Superintendent, Golden Crest Mining Co.

Stuart, Malcolm M., '08............*1228 Sherman St., Denver, Colo.*

Suhr, Otto B., '95.................................*Provo, Utah*
Telluride Power Co.

Taggart, George K., '03.....................*Llano, Sonora, Mexico*
Superintendent, Llano M. & M. Co.

Taylor, Harry P., '00.....................*Box 368, Goldfield, Nev.*
Mohawk Mine.

Terrill, A. C., '05..................................*Moscow, Ida.*
Professor of Metallurgy, University of Idaho.

Tescher, Samuel, '04.............*17th and Blake Sts., Denver, Colo.*
Care Louis Tescher.

Thomas, John S., '04...
Deceased.

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Pueblo Plant, A. S. & R. Co.

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Professor of Mining and Metallurgy, State College of Washington.

Thompson, James S., '99, ...*Stone Canon, Calif.*
Superintendent, Stone Canon Consolidated Coal Co.

Thum, Ernest E., '06...........................*Anaconda, Mont.*
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Titsworth, Frederick S., '95.......*407 Equitable Bldg., Denver, Colo.*
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Steptoe Mining & Milling Co.
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Supervisor, Mining Department, Culebic Division.
Ward, William F., '03............*416 E. and C. Bldg., Denver, Colo.*
Mining Engineer.
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Bureau of Lands.
Warnecke, Carl M., '97..........................*Sherman, Calif.*
Engineer, Los Angeles and Pacific Ry.
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Federal Lead Co.
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Assistant Superintendent, Ojuela Mine, Compania Minera de Penoles.
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Weed, Floyd, '97...................*467 Emerson St., Denver, Colo.*
Weil, Jacob, '04............................*Breckenridge, Colo.*
Pitt Ores Co.
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U. S. Reclamation Service, North Platte Project.
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....*Santa Rosa, District La Union, Salvador, Central America*
Assayers for Butters Salvador Mines.
Wertheim, Salomonson, '89...............................
Deceased.
Wheeler, Charles E., '94........................*Lampajos, Mexico*
Wheeler, Robert M., '08..............................*Ray, Ariz.*
Whitaker, Orvil R., '98...........*Ojuela, Mapimi, Durango, Mexico*
General Superintendent, Cia Minera de Penoles.
White, J. L., '07................................*El Tiro, Ariz.*
Engineer, El Tiro Copper Co.
Whitehouse, Howard D., '08...................*Colorado City, Colo.*
Wiley, Walter H., '83......*367 Bonnie Brae St., Los Angeles, Calif.*
Mining Engineer.

Williams, Fred T., '01............................*Park City, Utah*
Ontario Silver Mining Co.

Williams, Wakely A., '99........................*Grand Forks, B. C.*
Superintendent, Granby Smelter.

Wolf, A. G., '07................................*Telluride, Colo.*
Smuggler Union Mining Co.

Wolf, Harry J., '03..............*503 Colorado Bldg., Denver, Colo.*
Superintendent, Stanley Mining Co.

Woods, Thomas H., '97..............................*Ouray, Colo.*
Superintendent, Camp Bird Mill.

Young, Frank B., '95..............................*Lindsay, Calif.*
Mining Engineer.

Zulch, Charles H., '08........................*Cripple Creek, Colo.*
With Fred W. Crosley, Mining Engineer.

The Honorary Degree of the school has been conferred upon the following:

Berthoud, Capt. E. L..
Deceased.

Blow, A. A...................................*London, England*
Mining Engineer.

Hale, Gen. Irving..................................*Denver, Colo.*
General Agent, Gen. Electric Co.

Bulkley, Frank.....................................*Denver, Colo.*
Mining Engineer.

McDonald, Jesse F..................................*Denver, Colo.*
Governor of Colorado.

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Virginia	2
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Michigan	1
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1918-12

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QUARTERLY

OF THE

COLORADO
SCHOOL OF MINES

Vol. V. No. 4.

Catalogue Edition

GOLDEN, COLORADO
1910-1912

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COLLEGE CALENDAR.

1910.

November 24, Thursday	Thanksgiving Recess.
November 25, Friday	
November 26, Saturday	
December 22, Thursday	Christmas Recess Begins.

1911.

January 4, Wednesday	Christmas Recess Ends.
January 21, Saturday	First Semester Ends.
January 23, Monday	Second Semester Begins.
February 22, Wednesday	Washington's Birthday. (A Holiday).
May 26, Friday	Second Semester Ends. Commencement Exercises.
August 30, Wednesday	Examinations for entrance to the class of 1915, and re-examination of matriculated students.
August 31, Thursday	
September 1, Friday	
September 5, Tuesday	Opening of the first Semester of the Academic year 1911-12.
November 30, Thursday	Thanksgiving Recess.
December 1, Friday	
December 2, Saturday	
December 21, Thursday	Christmas Recess Begins

1912.

January 3, Wednesday	Christmas Recess Ends.
January 20, Saturday	First Semester Ends.
January 22, Monday	Second Semester Begins.
February 12, Monday	Lincoln's Birthday. (A Holiday).
February 22, Thursday	Washington's Birthday. (A Holiday).
May 22, Friday	Second Semester Ends. Commencement Exercises.
September 2, Wednesday	Examinations for entrance to the class of 1916, and re-examination of matriculated students.
September 3, Thursday	
September 4, Friday	
September 8, Tuesday	Opening of the first Semester of the Academic year 1912-13.

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HARRY MUNSON SHOWMAN, E. M.,
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Massachusetts Institute of Technology.
Ore Dressing.

GEORGE E. COLLINS, Denver, Colo.
Consulting Engineer.
Some lessons to be drawn from Gilpin County mining and mill practice.
Economics of Mining.

SILAS KNOWLES, Denver, Colo.
The caving system as evolved at the Boston Consolidated Mine.

A. W. WARWICK, Denver, Colo.
Mining Engineer.
The importance of the elements of astronomy to the mining engineer.
The development of simple methods of determining latitude, meridian, and time.
Practical methods of solar and stellar observations.

C. S. HURTER, Wilmington, Del.
E. I. du Pont de Nemours Powder Co.
The value and use of explosives.

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Thermit and its uses, with demonstrations.

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The development of coal mining machinery.

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University of Utah.
Sizing, concentration, and classifying.

F. G. REDINGTON, Denver, Colo.
District Forester.
The relation of the Forestry Bureau to the Mining Industry.

J. V. N. DORR, Black Hills, S. D.
The Dorr Classifier and the Dorr Continuous Slime Settler.

S. R. SWAIN, Denver, Colo.
Concentrating tables.

LUCIEN I. BLAKE, Boston, Mass.
Consulting Engineer, Submarine Signalling Co.
The place and importance of the imagination in a technical education.

BENEDICT SHUBART, Denver, Colo.
Lindrooth, Shubart & Company.
Coal Mining Plant Design.

RALPH PADDOCK, Denver, Colo.
Jeffrey Manufacturing Co.
Electricity in Mining.

H. L. SINCLAIR, Denver, Colo.
Fairbanks, Morse & Co.
Nissen Stamps.

FRANK E. SHEPARD, Denver, Colo.
President, Denver Engineering Works Co.
Crushing.

AXEL E. ANDERSON, Wilmington, Del.
E. I. du Pont de Nemours Powder Co.
The Uses and Properties of Explosives.

CHARLES A. GEHRMAN, '86, San Francisco, Calif.
Prospecting in Nevada.

J. C. ROBERTS, Washington, D. C.
Mining Engineer.
The Work of the Pittsburg Testing Station.

HISTORY, ORGANIZATION, FINANCIAL SUPPORT, AND LOCATION.

HISTORY.

The Colorado School of Mines was established by an act of the Territorial Legislature, approved February 9, 1874. After an unsatisfactory experience in temporary quarters, the school was permanently housed in the original "building of 1880," upon land given by the citizens of Golden. Since then the School has enjoyed a strong and steady growth in buildings, in equipment, in students, in Faculty, and in the strength and rigor of its courses. Additions were made to the original building of 1880, by the buildings of 1882, and by the building of 1890, now united and called the Hall of Chemistry. The Hall of Physics was erected in 1894, the Assay Laboratory in 1900, and Stratton Hall in 1904. The Heating, Lighting, and Power Plant was completed in 1906. The new Administration Building, named Simon Guggenheim Hall, for the donor, was also erected in 1906. The Gymnasium was completed in 1908. The Experimental Ore Dressing and Metallurgical Building was erected in 1910.

ORGANIZATION.

The corporate name of the institution by statute is "The School of Mines." The general management of the Colorado School of Mines is vested by statute in a Board of Trustees, consisting of five members appointed by the Governor of the State, with the advice and consent of the Senate. The members of the Board of Trustees are appointed in alternating sets of two and three, and hold their office for a period of four years and until their successors are appointed and qualified. The Board of Trustees elect one of their number President. They also appoint a Secretary and a Treasurer either from their own number, or from some other suitable persons, as they may deem best. Any three of the Board of Trustees constitute a quorum for the transaction of business. By the organic Constitution of Colorado, the School of Mines is regarded as an Institution of the State.

FINANCIAL SUPPORT.

The Colorado School of Mines is supported by the income derived from the annual tax of one-fifth of a mill on each dollar of the assessed property of the State, and this is known as the "School of Mines Tax." In addition to this the Legislature has, from time to time, provided by special appropriation for such emergency funds as the means of the State treasury and the necessities of the School might suggest.

LOCATION.

The Colorado School of Mines is in the south central part of the city of Golden, Jefferson County, Colorado. Golden is about thirteen miles from Denver, and can be reached by the Colorado & Southern Railroad from the Union Station, at the foot of Seventeenth street; by the Denver and Intermountain Railway, from the Arapahoe street station, between Fourteenth and Fifteenth streets; or by the Denver & Northwestern Electric Railway, from the loop on Fifteenth street, between Arapahoe and Lawrence streets, Denver.

Golden has about three thousand inhabitants and is one of the oldest cities in Colorado. It is such a residence town as usually clusters around a college, and is the most available foothill home suburban to Denver. The altitude is five thousand seven hundred feet above sea level, or about four hundred fifty feet higher than Denver. The climate is invigorating and pleasant, with open winters and a large proportion of clear days. The surrounding region is rich in the characteristic scenery of the Rocky Mountain region.

The Colorado School of Mines is peculiarly well situated to give students both a theoretical and a practical training. The equipment of the school enables the theoretical side to be well presented. The nearness to mines, mills, and smelters offers unusual opportunities for inspection visits, and enables the student to see in actual operation every variety of mining and metallurgical work. The North American Smeltery is located at Golden. In the Clear Creek canon are the numerous gold mills and concentrators of Gilpin and Clear Creek counties. At the Globe plant of the American Smelting and Refining Company, the treatment of lead ores and dry ores of gold and silver is illustrated. The Colorado Zinc Works, using modern methods of magnetic and electric separation, is also in Denver. The many mining and metallurgical machinery plants of the city afford an excellent opportunity for becoming acquainted with recent improvements in metallurgical design. At Colorado City are the Portland and Standard mills for the chlorination treatment of gold ores, and the Golden Cycle mill for cyanidation; at Cripple Creek the Cripple Creek and Homestake mills; at Victor, the Independence and the Portland mills; and at Florence, the Union mill. The plant of the Colorado Fuel and Iron Company at Pueblo possesses all the recently invented and approved devices for the production of iron and steel and for the working of these products into marketable forms. At Pueblo are three lead smelteries, the Pueblo, Eilers, and the Philadelphia, and the zinc smeltery of the Colorado Zinc Company. At Canon City are the plants of the Empire Zinc Company and of the United States Reduction and Refining Company; at Salida, the Ohio and Colorado smeltery, and at Leadville, the Arkansas Valley smeltery. The Black Hills, where good practice in gold milling and cyanidation is to be found, and the great copper smelteries of Montana, are easily reached.

At or near Golden are numerous clay mines and quarries and extensive coal mines well equipped with hoisting and power machinery. In the Clear Creek canon, within a short ride of Golden, are the mining camps of Central City, Black Hawk, Idaho Springs, and Georgetown. Placer mining is carried on at Breckenridge. The well-known mining camps at Cripple Creek, Victor, Leadville, and Aspen, as well as the San Juan region including Silverton, Ouray, and Telluride, are also easily reached by train from Denver. Besides these the bituminous mines of the northern coal fields, the anthracite fields of Glenwood Springs, the oil fields of Florence, the iron mines of Wyoming, and the copper regions of Arizona and Montana, are easily available.

No other mining school in the country has within easy access such a wide variety of mining properties, or such excellent opportunities for observing the latest and best milling and smelting operations.

REQUIREMENTS FOR ADMISSION

FRESHMAN CLASS.

Unit Course. A unit course of study is defined as a course covering a school year of not less than thirty-six weeks, with five periods of at least forty minutes each per week.

Fifteen Units are required for entrance, of which twelve are specified, and three may be chosen from a list of electives.

SPECIFIED UNITS.

Essentials of Algebra	1	unit
Advanced Algebra	½	unit
Plane Geometry	1	unit
Solid Geometry	½	unit
Languages, other than English	2	units
English	3	units
History	2	units
Physics	1	unit
Chemistry	1	unit
Specified Units	12	
Elective Units	3	
Total Units for Entrance	15	

ELECTIVE UNITS.

The three elective units may be selected from the following list: Drawing, Shop Work, Mathematics, Greek, French, German, Spanish, History, English, Science, Psychology, Political Economy.

In allowing credit for drawing and shop work two forty-minute periods will be regarded as equivalent to one forty-minute period of classroom work. Half units are accepted in all studies, except in physics and chemistry, provided that not less than one full unit shall be accepted in language.

METHODS OF ENTRANCE.

(a) By Certificate.

Graduates of Accredited High Schools in the State of Colorado will be admitted without examination upon the presentation of proper credentials from the Principal of their High School, provided that the studies they have successfully completed cover the requirements for admission. Blanks for this purpose will be sent, on application to the President.

Graduates of Accredited High Schools in other States will be accepted in the same manner as graduates of Accredited High Schools in Colorado.

(b) By Examination.

All other candidates for admission will be required to pass entrance examinations. These examinations are held in Golden.

For the benefit of students who cannot, on account of the distance, conveniently take the examination at Golden, arrangements will be made so that they may take the examination under the direction of some responsible person at or near their own homes.

Entrance examinations for the class of 1915 will be held in Golden on Wednesday, Thursday and Friday, August 30, 31, and September 1, 1911.

Entrance examinations for the class of 1916 will be held in Golden on Wednesday, Thursday and Friday, September 2, 3, and 4, 1912.

It is the opinion of the Faculty of the Colorado School of Mines that every candidate for the Freshman class should have taken a thorough course of at least four years in a good High School or in a Manual Training High School, and during the last year of his preparation, should have a thorough review of mathematics, or should have received an education equivalent to one of these. The work of the school is so exacting that students who are not well prepared cannot expect to succeed after entrance. Special attention should be given to the preparation in physics, chemistry, and mathematics.

DESCRIPTION OF THE UNITS REQUIRED FOR ENTRANCE.

ENGLISH (3 UNITS).

(a) GRAMMAR. The student should have a sufficient knowledge of English grammar to enable him to point out the syntactical structure of any sentence which he encounters in the prescribed reading. He should also be able to state intelligently the leading grammatical principles when he is called upon to do so.

(b) READING. The books prescribed by the Joint Committee on Uniform Entrance Requirements in English form the basis for this part of the work.

The list is divided into two parts; the first consists of books to be read with attention to their contents rather than to their form; the second consists of books to be studied thoroughly and minutely. The lists, thus divided, are as follows:

I. Books prescribed for reading.

Group I. (Two to be selected).

Shakespeare's *As You Like It, Henry V, Julius Caesar, The Merchant of Venice, Twelfth Night.*

Group II. (One to be selected).

Bacon's *Essays*, Bunyan's *The Pilgrim's Progress, Part I; The Sir Roger de Coverley Papers* in *The Spectator;* Franklin's *Autobiography.*

Group III. (One to be selected).

Chaucer's *Prologue;* Spencer's *Faerie Queene* (selections); Pope's *The Rape of the Lock;* Goldsmith's *The Deserted Village;* Palgrave's *Golden Treasury (First Series), Books II. and III.*, with special attention to Dryden, Collins, Gray, Cowper, and Burns.

Group IV. (Two to be selected).

Goldsmith's *The Vicar of Wakefield;* Scott's *Ivanhoe;* Scott's *Quentin Durward;* Hawthorne's *The House of the Seven Gables;* Thackeray's *Henry Esmond;* Mrs. Gaskell's *Cranford;* Dickens' *A Tale of Two Cities;* George Eliot's *Silas Marner;* Blackmore's *Lorna Doone.*

Group V. (Two to be selected).

Irving's *Sketch Book;* Lamb's *Essays of Elia;* De Quincy's *Joan of Arc* and *The English Mail Coach;* Carlyle's *Heroes and Hero Worship;* Emerson's *Essays;* Ruskin's *Sesame and Lilies.*

Group VI. (Two to be selected).

Coleridge's *The Ancient Mariner;* Scott's *The Lady of the Lake;* Byron's *Mazeppa* and *The Prisoner of Chillon;* Palgrave's *Golden Treasury (First Series), Book IV.*, with special attention to Wordsworth, Keats, and Shelley; Macauley's *Lays of Ancient Rome;* Poe's *Poems;* Lowell's *The Vision of Sir Launfal;* Arnold's *Sohrab and Rustum;* Longfellow's *The Courtship of Miles Standish;* Tennyson's *Gareth and Lynette, Lancelot and Elaine,* and *The Passing of Arthur;* Browning's *Cavalier Tunes, The Lost Leader, How They Brought the Good News from Ghent to Aix, Evelyn Hope, Home Thoughts from Abroad, Home Thoughts from the Sea, Incident of the French Camp, The Boy and the Angel, One Word More, Herve Riel, Phedippides.*

II. Books prescribed for study and practice.

Shakespeare's *Macbeth;* Milton's *Lycidas, Comus, L'Allegro,* and *Il Penseroso;* Burke's *Speech on Conciliation with America* or Washington's *Farewell Address* and Webster's *First Bunker Hill Oration;* Macauley's *Life of Johnson,* or Carlyle's *Essay on Burns.*

(c) COMPOSITION. Regular and persistent training in both written and oral composition should be given throughout the entire school course. The topics should be chosen so as to give practice in the four leading types of prose discourse, namely, description, narration, exposition, and argument.

(d) RHETORIC. The instruction in this subject should include the following particulars: choice of words, structure of sentences and paragraphs, the principles of narration, description, exposition, and argument. The teacher should distinguish between those parts of rhetorical theory which are retained in text books merely through the influence of tradition and those which have a direct bearing upon the composition work. The former may be safely omitted.

HISTORY (2 UNITS).

Any two of the following may be offered.

I. Ancient History, with special reference to Greek and Roman History, with a short introductory study of the more ancient nations and the chief events of the early middle ages, down to the death of Charlemagne.

II. Mediaeval and Modern European History, from the death of Charlemagne to the present time.

III. English History.

IV. American History, or American History and Civil Government.

PHYSICS (I UNIT).

PHYSICS. The equivalent of Carhart and Chute's *High School Physics*, or Gage's *Principles of Physics*, together with systematic laboratory practice such as is outlined in Crew and Tatnall's *Laboratory Manual in Physics.*

CHEMISTRY (1 UNIT).

GENERAL CHEMISTRY. The equivalent of Bradbury's *Elementary Chemistry* or Remsen's *Briefer Course of Inorganic Chemistry, with Experiments.*

MATHEMATICS (3 UNITS).

I. ESSENTIALS OF ALGEBRA. (1 Unit). The four fundamental operations for rational algebraic expressions; factoring: complex fractions; the solution of equations of the first degree containing one or more unknown quantities; radicals; theory of indices; quadratic equations and equations containing one or more unknown quantities that can be solved by the methods of quadratic equations; problems dependent on such equations.

II. ADVANCED ALGEBRA. (½ Unit). This course should begin with a thorough review of the essentials. Later work should cover an introduction to the graphical representation of linear and simple quadratic expressions; ratio and proportion; variation; binominal theorem; the progressions; an elementary treatment of series; partial fractions; complex numbers and logarithms.

III. PLANE GEOMETRY. (I Unit). Completed, including the solution of original exercises and numerical problems.

IV. SOLID GEOMETRY. (½ Unit). Properties of straight lines and planes; of dihedral and polyhedral angles; of projection; of polyhedrons, including prisms; of pyramids and the regular solids; of cylinders, cones and spheres; of spherical triangles, and the measurement of surfaces and solids.

The two units required in languages other than English may be offered in Greek, Latin, French, German, or Spanish.

ADMISSION TO ADVANCED STANDING.

Applicants who are graduates of technical or scientific schools or colleges of good standing will be admitted without examination upon the presentation of proper credentials and will be permitted to take any subject taught in connection with the regular courses, provided in the opinion of the instructor their previous experience and training will enable them to pursue the subject with profit. Each case will be judged on its own merits, but applicants will be advised to become candidates for a degree and to complete one of the regular courses of the college. Graduates will find the advanced work of the school well adapted to fit them for professional engineering work.

Applicants who have partially completed the course in technical or scientific schools or colleges of good standing will be admitted without examination upon the presentation of proper credentials. Due credit will be allowed for the successful completion of work which is equivalent to that given in the Colorado School of Mines. Plates of drawing, laboratory note books, and catalogues of the institution attended, should be submitted with applications for advanced standing. *The college does not admit special students.* All applicants for advanced standing are expected to enroll in one of the regular classes and to become candidates for a degree. All credits given to advanced standing students are given provisionally, with the understanding that they may be withdrawn at any time in case a student fails to maintain a creditable standing. Application blanks will be furnished on request to the President.

DEPARTMENTS OF INSTRUCTION.

COURSES OF STUDY.

DEGREE.

The degree of E. M. (Engineer of Mines) will be conferred upon a candidate who

(a) Completes the prescribed work of the Freshman and Sophomore years.

(b) Completes the prescribed work in one of the four groups—Metal Mining, Coal Mining, Metallurgy, or Mining Geology—including the regularly prescribed trips, metallurgical practice, and field work.

(c) Completes enough additional work to make a total of 100 credit hours for the Junior and Senior years, exclusive of the regular trips, metallurgical practice, and field work.

(d) Takes the Senior Trip and presents an acceptable thesis.

Each senior must submit to the Faculty, not later than November 1st, the subject of his thesis, which must be approved by the professor concerned. Each thesis must be typewritten or printed on eight and one-half by eleven-inch paper, bound in book form, and submitted not later than May 1st.

No diploma will be delivered until the thesis is handed in, the full requirements of the course of study are satisfied, and all accounts with the college are settled.

TABULAR VIEW.

Freshman Year.

Required of all students.

FIRST SEMESTER.	Lect. Hr.	Lab. Hr.	SECOND SEMESTER.	Lect. Hr.	Lab. Hr.
College Algebra (p. 87)	5		Analytic Geometry (p. 88)	5	
Trigonometry (p. 88)	3		Calculus (p. 88)	3	
General Chemistry (p. 77)	5		General Chemistry (p. 77)	5	
Qualitative Analysis (p. 78)			Qualitative Analysis (p. 78)		
Lectures	2		Lectures	2	
Laboratory		6	Laboratory		12
Descriptive Geometry (p. 66)			Elementary Machine Design (p. 66)		
Lectures	2		Lectures	2	
Drawing		9	Drawing		6
General Geology (p. 54)	3		General Geology (p. 55)	3	

The courses are described on the pages indicated after each course.

TABULAR VIEW.

Sophomore Year.

Required of all students.

First Semester.	Lect Hr.	Lab. Hr.	Second Semester.	Lect. Hr.	Lab. Hr.
Calculus (p. 89)	5		Calculus (p. 89)	5	
Physics (p. 85)			Physics (p. 86)		
Lectures	5		Lectures	5	
Laboratory		4	Laboratory		4
Industrial Chemistry (p. 79)	2		Industrial Chemistry (p. 79)	2	
Qualitative Analysis (p. 79)			Quantitative Analysis (p. 80)		
Lectures	1		Lectures	1	
Laboratory		6	Laboratory		6
Machine Design (p. 67)			Machine Design (p. 68)		
Lectures	2		Lectures	2	
Drawing		3	Drawing		3
Crystallography (p. 55)			Mineralogy (p. 55)		
Lectures	2		Lectures	2	
Laboratory		6	Laboratory		6

Plane Surveying, Lectures and Field Work, (p. 61) for six weeks in the summer after the close of the Sophomore year.

The courses are described on the pages indicated after each course.

ERRATA—

Qualitative Analysis (p. 79)

Should Read:

Quantitative Analysis (p. 79). (See above).

TABULAR VIEW.

Group I. Metal Mining.

Junior Year.

First Semester.	Lect. Hr.	Lab. Hr.	Second Semester.	Lect. Hr	Lab. Hr.
Principles of Metal Mining (p. 38)	1		Principles of Metal Mining (p. 38)	1	
Credit 1.			Credit 1.		
Methods of Metal Mining (p. 39)	3		Methods of Metal Mining (p. 39)	3	
Credit 3.			Credit 3		
Mineral Land Surveying (p. 36)	2		Mine Surveying (p. 36)	2	
Credit 2.			Credit 2.		
Metallurgy (p. 46)	3		Metallurgy (p. 47)	3	
Credit 3.			Credit 3.		
Steam Engines and Boilers (p. 68)			Steam Engines and Boilers (p. 69)		
Lectures	1		Lectures	1	
Drawing		6	Drawing		6
Credit 3.			Credit 3.		
Quantitative Analysis (p.80)			Lithology (p. 56)		
Lectures	1		Lectures	2	
Laboratory		6	Laboratory		3
Credit 3.			Credit 3.		
Mechanics of Engineering (p. 61)			Mechanics of Engineering (p. 62)		
Lectures	5		Lectures	5	
Credit 5.			Laboratory		3
			Credit 6.		
Mining Trips (p. 99)			Mining Trips (p. 99)		
Metallurgical Trips (p. 99)			Metallurgical Trips (p. 99)		

Assaying (Metallurgy I.) (p. 45) lecture one hour, laboratory six hours, per week, must be taken in the Junior year, but may be taken in either semester. Credit 3.

Mine Surveying Field Work (p. 37) is given in the summer following the close of the Junior year. Credit 2½.

The specified credit hours for the year, exclusive of the regular trips, amount to 46½. The remaining credits, 3½, to make a total of 50 credits for the year, may be selected from the elective courses, or from courses offered in other groups.

TABULAR VIEW.

Group I. Metal Mining.

Senior Year.

FIRST SEMESTER.	Lect. Hr.	Lab. Hr.	SECOND SEMESTER.	Lect. Hr.	Lab. Hr.
Practices of Metal Mining (p. 40) Credit 2.	2		Practices of Metal Mining (p. 40) Credit 2.	2	
Mine Examinations and Reports (p. 42) Credit 1.	1		Economics of Metal Mining (p. 43) Credit 2.	2	
Mine Mapping (p. 38) Credit 1.		3			
Mining Laboratory (p. 43). Credit ½.					
Ore Dressing (p. 48)					
Lectures	4		Metallurgy (p. 49)	4	
Laboratory		3	Credit 4.		
Credit 5.					
Power Plant Design (p. 70)					
Lectures	2		Hydraulics (p. 63)		
Drawing		6	Lectures	2	
Credit 4.			Laboratory		3
Ore Deposits (p. 58) Credit 3.	3		Credit 3.		
Compressed Air (p. 69) Credit 2.	2		Economic Geology (p. 58) Credit 3.	3	
Thesis Credit 1.		3	Thesis Credit 2.		6
Mining Trips (p. 99)			Metallurgical Practice (p. 52)		
Ore Dressing Trips (p. 99)			Metallurgical Trips (p. 99)		
Geological Field Work (p. 57)					

The Geological Field Work is given during the first week of the Senior year.

The Metallurgical Practice is given during the week preceding the Senior Trip.

The Mining Laboratory is given in groups during the first semester.

The specified credit hours for the year, exclusive of the regular trips, the geological field work, the metallurgical practice, and the Senior Trip, amount to 35½. The remaining credits, 14½, to make a total of 50 credits for the year, may be selected from the elective courses, or from courses offered in other groups.

TABULAR VIEW.

Group II. Coal Mining.

Junior Year.

First Semester.	Lect. Hr.	Lab. Hr.	Second Semester.	Lect. Hr.	Lab. Hr.
Principles of Metal Mining (p. 38)	1		Principles of Metal Mining (p. 38)	1	
Credit 1.			Credit 1.		
Principles of Coal Mining (p. 41)	2		Methods of Coal Mining (p. 41)	2	
Credit 2.			Credit 2.		
Mineral Land Surveying (p. 36)	2		Mine Surveying (p. 36)	2	
Credit 2.			Credit 2.		
Metallurgy (p. 46)	3		Metallurgy (p. 47)	3	
Credit 3.			Credit 3.		
Steam Engines and Boilers (p. 68)			Steam Engines and Boilers (p. 69)		
Lectures	1		Lectures	1	
Drawing		6	Drawing		6
Credit 3.			Credit 3.		
Mechanics of Engineering (p. 61)			Mechanics of Engineering (p. 62)		
Lectures	5		Lectures	5	
Credit 5.			Laboratory		3
			Credit 6.		
Mining Trips (p. 99)			Mining Trips (p. 99)		
Metallurgical Trips (p. 99)			Metallurgical Trips (p. 99)		

Assaying (Metallurgy I.) (p. 45) lecture one hour, laboratory six hours, per week, must be taken during the Junior year, but may be taken in either semester. Credit 3.

Mine Surveying Field Work (p. 37) is given in the summer following the close of the Junior year. Credit 2½.

The specified credit hours for the year, exclusive of the regular trips, amount to 38½. The remaining credits, 11½, to make a total of 50 credits for the year, may be selected from the elective courses, or from courses offered in other groups.

TABULAR VIEW.

Group II. Coal Mining.

Senior Year.

FIRST SEMESTER.	Lect. Hr.	Lab. Hr.	SECOND SEMESTER.	Lect. Hr.	Lab. Hr.
Practices of Metal Mining (p. 40) Credit 2.	2		Practices of Metal Mining (p. 40) Credit 2.	2	
Practices of Coal Mining (p. 41) Credit 2.	2		Coal Mining Equipment (p. 42) Credit 2.	2	
Mine Examinations and Reports (p. 42) Credit 1.	1		Economics of Coal Mining (p. 44) Credit 1.	1	
Mine Mapping (p. 38) Credit 1.		3	Economics of Metal Mining (p. 43) Credit 2.	2	
Mining Laboratory (p. 43). Credit ½.					
Ore Dressing (p. 48) Lectures Laboratory Credit 5.	4	3	Coal and Gas Analysis (p. 82) Laboratory Credit 1.		3
Power Plant Design (p. 70) Lectures Drawing Credit 4.	2	6	Electricity (p. 75) Lectures Laboratory Credit 4.	3	3
Compressed Air (p. 69) Credit 2.	2				
Thesis Credit 1.		3	Thesis Credit 2.		6
Mining Trips (p. 99)			Mining Trips (p. 99)		
Ore Dressing Trips (p. 99)			Metallurgical Trips (p. 99)		
Geological Field Work (p. 57)			Metallurgical Practice (p. 52)		

The Mining Laboratory is given in groups during the first semester.

The Geological Field Work is given during the first week of the Senior year.

The Metallurgical Practice is given during the week preceding the Senior trip.

The specified credit hours for the year, exclusive of the regular trips, the geological field work, the metallurgical practice, and the Senior Trip amount to 32½. The remaining credits, 17½, to make a total of 50 credits for the year, may be selected from the elective courses, or from courses offered in other groups.

TABULAR VIEW.

Group III. Metallurgy.

Junior Year.

FIRST SEMESTER.	Lect Hr.	Lab. Hr.	SECOND SEMESTER.	Lect. Hr.	Lab. Hr.
Principles of Metal Mining (p. 38)	1		Principles of Metal Mining (p. 38)	1	
Credit 1.			Credit 1.		
Metallurgy (p. 46)	3		Metallurgy (p. 47)	3	
Credit 3.			Credit 3.		
Metallurgy (p. 47)	2		Metallurgy (p. 48)	2	
Credit 2.			Credit 2.		
Assaying (p. 45)					
Lectures	1				
Laboratory		9			
Credit 4.					
Quantitative Analysis (p. 80)			Metallurgical Chemistry (p. 81)		
Lectures	1		Lectures	1	
Laboratory		6	Laboratory		6
Credit 3.			Credit 3.		
Steam Engines and Boilers (p. 68)			Steam Engines and Boilers (p. 69)		
Lectures	1		Lectures	1	
Drawing		3	Drawing		3
Credit 2.			Credit 2.		
Mechanics of Engineering (p. 61)	5		Mechanics of Engineering (p. 62)	5	
Credit 5.			Credit 5.		
Mining Trips (p. 99)			Mining Trips (p. 99)		
Metallurgical Trips (p. 99)			Metallurgical Trips (p. 99)		

The specified credit hours for the year, exclusive of the regular trips, amount to 36. The remaining credits, 14, to make a total of 50 credits for the year may be selected from the elective courses, or from courses offered in other groups.

TABULAR VIEW.

Group III. Metallurgy.

Senior Year.

FIRST SEMESTER.	Lect. Hr.	Lab. Hr.	SECOND SEMESTER.	Lect. Hr.	Lab. Hr.
Methods of Metal Mining			Methods of Metal Mining		
(p. 39)	3		(p. 39)	3	
Credit 3.			Credit 3.		
Metallurgy (p. 48)			Metallurgy (p. 49)		
Lectures	3		Lectures	4	
Laboratory		3	Laboratory		3
Credit 4.			Credit 5.		
Electrometallurgy (p. 51)			Electrometallurgy (p. 51)		
Lectures	2		Lectures	2	
Laboratory		3	Credit 2.		
Credit 3.					
Metallography (p. 50)			Metallography (p. 50)		
Lectures	1		Laboratory		3
Credit 1.			Credit 1.		
Metallurgical Chemistry					
(p. 82)					
Lectures	1				
Laboratory		6			
Credit 3.					
Ore Dressing (p. 48)					
Lectures	4				
Laboratory		3			
Credit 5.					
Thesis		3	Thesis		6
Credit 1.			Credit 2.		
Mining Trips (p. 99)			Metallurgical Practice		
Ore Dressing Trips (p. 99)			(p. 52)		
			Metallurgical Trips (p. 99)		

The Metallurgical Practice is given during the week preceding the Senior Trip.

The specified credit hours for the year, exclusive of the regular trips, the metallurgical practice, and the Senior Trip, amount to 33. The remaining credits, 17, to make a total of 50 credits for the year, may be selected from the elective courses, or from courses offered in other groups.

TABULAR VIEW.

Group IV. Mining Geology.

Junior Year.

FIRST SEMESTER.	Lect. Hr.	Lab. Hr.	SECOND SEMESTER.	Lect. Hr.	Lab. Hr.
Principles of Metal Mining (p. 38) .... Credit 1.	1		Principles of Metal Mining (p. 38) .... Credit 1.	1	
Mineral Land Surveying (p. 36) .... Credit 2.	2		Mine Surveying (p. 36) .... Credit 2.	2	
Metallurgy (p. 46) .... Credit 3.	3		Metallurgy (p. 47) .... Credit 3.	3	
Advanced Geology (p. 56) . . Credit 5.	5		Lithology (p. 56)		
			Lectures	2	
			Laboratory		3
			Credit 3.		
Quantitative Analysis (p. 80)			Quantitative Analysis (p. 81)		
Lectures	1		Lectures	1	
Laboratory		6	Laboratory		6
Credit 3.			Credit 3.		
Mechanics of Engineering (p. 61) .... Credit 5.	5		Mechanics of Engineering (p. 62) .... Credit 5.	5	
Mining Trips (p. 99)			Mining Trips (p. 99)		
Metallurgical Trips (p. 99)			Metallurgical Trips (p. 99)		

Assaying (Metallurgy I.) (p. 45) lecture one hour, laboratory six hours, per week, must be taken in the Junior year, but may be taken in either semester. Credit 3.

Mine Surveying Field Work (p. 37) is given in the summer following the close of the Junior year. Credit 2½.

The Geological Field Work is done in the summer between the Junior and Senior years.

The specified credits for the year, exclusive of the regular trips, amount to 41½. The remaining credits, 8½, to make a total of 50 credits for the year, may be selected from the elective courses, or from courses offered in other groups.

TABULAR VIEW.

Group IV. Mining Geology.

Senior Year.

First Semester.	Lect. Hr.	Lab. Hr.	Second Semester.	Lect. Hr.	Lab. Hr.
Methods of Metal Mining (p. 39) Credit 3.	3		Methods of Metal Mining (p. 39) Credit 3.	3	
Mine Examinations and Reports (p. 42) Credit 1.	1		Economics of Metal Mining (p. 43) Credit 2.	2	
Mine Mapping (p. 38) Credit 1.		3	Metallurgy (p. 49) Credit 4.	4	
Ore Dressing (p. 48)					
Lectures	4				
Laboratory		3			
Credit 5.					
Ore Deposits (p. 58) Credit 3.	3		Mining Geology (p. 58) Credit 3.	3	
Microscopic Petrography (p. 57) Credit 3.		6	Economic Geology (p. 58) Credit 3.	3	
Geological Field Work (p. 57) Credit 3.			Geological Chemistry (p. 82)		
			Lectures	1	
			Laboratory		6
			Credit 3.		
Thesis Credit 1.		3	Thesis Credit 2.		6
Mining Trips (p. 99)			Metallurgical Practice (p. 52)		
Ore Dressing Trips (p. 99)			Metallurgical Trips (p. 99)		

The Metallurgical Practice is given during the week preceding the Senior Trip.

The Geological Field Work is given in the summer between the Junior and Senior years.

The specified credit hours for the year, exclusive of the regular trips, the metallurgical practice, and the Senior Trip, amount to 40. The remaining credits, 10, to make a total of 50 credits for the year, may be selected from the elective courses, or from courses offered in other groups.

POSTGRADUATE DEPARTMENT.

The degree of M. S. (Master of Science) will be conferred upon a candidate who already holds the degree of Engineer of Mines, or its equivalent, according to the standard of the Colorado School of Mines, who completes work equivalent to fifty credit hours chosen with the approval of the Faculty from either the postgraduate or undergraduate courses, and who presents an acceptable thesis.

The following postgraduate courses are offered:

Rare Metals	Professor Fleck	(p. 83)
Physical Chemistry	Assistant Professor Test	(p. 83)
Electrochemical Analysis	Assistant Professor Test	(p. 84)
Practical Astronomy	Professor Burger	(p. 90)
Precise Surveying and Geodesy	Professor Burger	(p. 90)
Radioactivity and Spectroscopy	Professor Miller	(p. 86)
Gems and Gem Mining	Assistant Professor Butler	(p. 59)
Ceramic Geology	Assistant Professor Butler	(p. 59)
Glacial Geology	Assistant Professor C. E. Smith	(p. 60)
Advanced General Metallurgy	Professor Traphagen	(p. 52)
Advanced Mine and Mill Design	Professor Allison	(p. 65)
Advanced Hydraulic Design	Professor Allison	(p. 65)
Mine Plant Testing	Professor Cronin	(p. 74)
Coal Testing	Professor Cronin	(p. 73)
Mine Plant Design	Professor Cronin	(p. 72)
Metallurgical Plant Design	Professor Cronin	(p. 73)
Gas Engine Design	Assistant Professor Otis	(p. 73)
Advanced Metallography	Professor Haldane	(p. 53)

MINING.

Professor Arthur Joseph Hoskin.
Assistant Professor Alwyn Charles Smith.

The courses given in this department are intended to instruct the student in the theoretical as well as the practical subjects that are necessary to a thorough comprehension of the mining industry. The subjects range from the most elementary to those that teach the principles of mining, the various schemes or methods of developing and working mines, and the actual or practical operations involved in mining. Throughout these courses it is aimed to present the most approved ideas and to have the student feel that he is receiving instruction that is revised up to the time of presentation.

No text books are used except in Courses XV. and XVI. Numerous references are given for outside reading of books and current journals.

I. MINERAL LAND SURVEYING. *Lectures.*

Credit two hours.

This course teaches the student the problems that commonly confront United States Mineral Surveyors. Among the topics pre sented are: the elementary astronomical facts pertaining to the Celestial Sphere and to the so-called PZS triangle; corrections to be applied to field observations and to other data used in calculations; methods for determining latitude, longitude, meridian, and time; legal requirements in patenting mineral lands, more particularly lode claims, placer claims, mill sites, and tunnel sites; the duties of a U. S. Mineral Surveyor; actual and hypothetical problems given in the examinations of applicants for commissions as Mineral Surveyors; the legal subdivison of the public domain; the fitting of lode lines to claims; the preparation from field notes of a complete set of patent papers for filing in the Surveyor-General's Office and the Land Office.

Prerequisites: Completed work of the Freshman year.
Mathematics VI.
Civil Engineering I.

Two hours per week during the first semester of the Junior year.

Required in Groups I., II., and IV.

(A. C. Smith.)

II. MINE SURVEYING. *Lectures.*

Credit two hours.

Among the subjects covered by this course are the following: the establishment of the meridian underground; the making of connections between mine workings; the use of hand transits and auxiliary telescopes; the determination of dip, strike, and thickness of mineral deposits from drill-hole data; the importance of taking accurate and systematic notes and sketches during surveys, with recent approved methods; the recording of field data in the office; the proper use and care of equipment for performing underground surveys; the organization of surveying parties in mines and the responsibilities of the various members; the laying-out of mine openings and passages to secure the most economical development, drainage, haulage, and production.

Prerequisite: Course I.

Two hours per week during the second semester of the Junior year.

Required in Groups I., II., and IV.

(A. C. Smith.)

III. MINE SURVEYING. *Field Work.*

Credit two and one-half hours.

This course is planned to co-ordinate with Courses I. and II. and so embraces two distinct kinds of practice. The field work given to exemplify the lectures in Course I. includes the laying-out of one each of the following mineral land claims, viz., a mill site, a placer claim, a rectangular lode claim, an angular lode claim, and a tunnel site. These surveys are made in the foothills adjacent to Golden. The difficulties encountered are much the same as those which the U. S. Mineral Surveyor meets in his practice. This part of the field practice consumes about two weeks. The student is next taken to one of the Colorado mining districts where he assists in the complete surface and underground survey of two or more mines. The work is done with such detail as to secure sufficient data for use subsequently in Course IV. The usual difficulties of such practices are given special emphasis and the student is made to see the reasons for extreme caution in all of his work. He also becomes familiar with regular working conditions of mines and meets many practical problems which must be solved during the progress of his work. The mines selected for this practice present opportunities for the exercise of the surveyor's ingenuity since the workings are not only extensive but complicated. In the work of this course the students are formed into small parties so that, by rotation in duties, skill is acquired by each man in the various lines of work.

Prerequisites: Courses I. and II.

Four weeks following the close of the second semester of the Junior year.

Required in Groups I., II., and IV.

(Hoskin, A. C. Smith.)

IV. MINE MAPPING. *Drawing.*

Credit one hour.

This is a drafting room course. In a way somewhat similar to that carried out in Course III., this course is designed to give experience in two different lines of work. The first half of the course is devoted to instruction in mineral land mapping. Accuracy in protracting, drawing, and scaling of boundaries, of intersections and of areas is emphasized. The examples given to the class are actual cases taken from the records of the United States Surveyor-General. This practice is intended to prepare the student for the rigid examinations that now precede the granting of commissions to United States Mineral Surveyors. The balance of the course is devoted to the making of mine maps. The work proceeds along approved methods with actual mine surveys used as data. The various projections usually adopted to represent mine workings are produced on paper. The student is required to determine graphically certain definite underground closures or connections. To add reality to his experience, the student concludes this course with the mapping of mines which he has previously surveyed in Course III.

Prerequisites: Course III.
Completed work of the Freshman and Sophomore years.

Three hours per week during first semester of the Senior year.

Required in Groups I., II., and IV.

(Hoskin.)

V. PRINCIPLES OF METAL MINING. *Lectures.*

Credit one hour.

This course is introductory and fundamental to all the succeeding metal mining courses. It has none of the technical features which are prominent in some of the later courses. The main topics discussed are the history and importance of the industry; its influence in the settlement and civilization of the world; the principal ore mines and districts with their general characteristics and their approximate productions.

Prerequisites: Completed work of the Freshman year.
Geology and Mineralogy, IV.

One hour per week during the first semester of the Junior year.

Required in Groups I., II., III., and IV.

(Hoskin.)

VI. PRINCIPLES OF METAL MINING. *Lectures.*

Credit one hour.

This is a continuation of Course V. and is largely theoretical. The general topics discussed are: definitions of elementary terms in metal mining; the distinctions to be drawn between mines and prospects; the general types of ore bodies; the occurrence of the ore-making minerals and gangues; and the scientific methods of prospecting for metals.

Prerequite: Course V.

One hour per week during the second semester of the Junior year.

Required in Groups I., II., III., and IV.

(Hoskin.)

VII. METHODS OF METAL MINING. *Lectures.*

Credit three hours.

This course begins with the study of placering and goes into the details of sluicing, hydraulicking, dredging, drift mining, and dry placering. At the conclusion of this subject the class is taken on a trip to a placer mining district. The prospecting of shallow and deep ore bodies by churn, diamond, and other drills is next considered. Then follow the descriptions of the open pit and milling systems of working surface mines, with special details of steam shovel practices. The various kinds of openings into underground deposits, with their relative merits, are discussed and the systems of driving horizontal passages and of sinking and upraising are explained. The special methods adopted for various conditions of ground, the handling of the excavated materials, and the organization of working crews are taught.

Prerequisites: Completed work of the Freshman year.
Geology and Mineralogy, IV.

Three hours per week during the first semester.

Required in the Junior year of Group I. and the Senior year of Groups III. and IV.

(A. C. Smith.)

VIII. METHODS OF METAL MINING. *Lectures.*

Credit three hours.

The support of underground passages is first taken up for study and the usual methods of timbering and lining shafts, adits, levels, and stopes are discussed, with the appropriate uses of wood, steel, and concrete. The course next takes up the ways of blocking out bodies of ore and considers the correct intervals to be observed between successive levels, upraises, or other development passages. Then the various schemes for extracting ore bodies are explained and the student is taught the reason for attacking wide, narrow, steep, and flat deposits in differing ways. Underhand, overhand, shrinkage, and drill stoping, caving, slicing, filling and flushing are among the methods described.

In Courses VII. and VIII. specific cases are considered and the costs of equipment and operation as well as the rates of progress are given.

Prerequisite: Course VII.

Three hours per week during the second semester.

Required in the Junior year of Group I. and the Senior year of Groups III. and IV.

(A. C. Smith.)

IX. PRACTICES OF METAL MINING. *Lectures.*

Credit of two hours.

With this course, the student begins the study of the practical operations involved in metal mining. Rock drills are explained and the student is taught the distinguishing features of the various types. Then follow the systematic placing and drilling of holes for different purposes; the handling of explosives; the loading and firing of shots and the causes of failures and accidents in the use of explosives. Under the general subject of hoisting the following are among the topics considered: evolution of hoisting; primitive methods and those making use of muscular power; present types of hoisting engines using the common forms of energy; problems involved in handling products from deep mines; hoisting in balance; tail rope; fleeting, traversing, Koepe, and Whiting systems; manufacture, use, and repair of round and flat cables; the several kinds of hoisting conveyances; signals; safety devices. Mine drainage is next studied. This does not include pumping, but gives details of seepage; water levels; influence of depths and seasons; connecting flooded workings; the establishment of sumps, mine dams, bulkheads, and barrier pillars.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses VI. and VIII.

Two hours per week during the first semester of the Senior year.

Required in Groups I. and II.

(Hoskin.)

X. PRACTICES OF METAL MINING. *Lectures.*

Credit two hours.

The general subject of metal mine haulage is first taken up. Manual and animal transport of ore underground leads on to mechanical haulage and to the study of locomotives operated by electricity, compressed air, and internal combustion. The discussion covers capacities, costs of installation, operation, and maintenance; the relative merits of the different types of mine locomotives; haulage problems involving grade, load, and conditions of track; wiring, piping, and track laying. This course includes the miscellaneous equipment of metal mines along such lines as the various types of headframes; skip-changing devices; ore houses; the arrangement of buildings containing surface machinery; timber framing plants; shops; aerial and surface tramways. The course concludes with lectures descriptive of the metal mines which are visited on the Senior Trip.

Prerequisite: Course IX.

Two hours per week during the second semester of the Senior year.

Required in Groups I. and II. (Hoskin.)

XI. PRINCIPLES OF COAL MINING. *Lectures.*

The subjects given in this course are introductory to the broad study of mining coal. They include: the history and the growing importance of the coal mining industry; the geographical distribution of coal, with special reference to coal fields in the United States; the general geological features of coal areas; the origin of coal; the kinds of coal; the varieties known in the market; approximate productions and consumption; structural features of coal beds, such as cleavage, impurities, faulting, and rolling; prospecting of coal-bearing areas; the examination of and reporting on developed coal properties. The definition of coal mining terms is one of the features of this course.

Prerequisites: Completed work of the Freshman year.
Geology and Mineralogy, IV.

Two hours per week during the first semester of the Junior year.

Required in Group II. (A. C. Smith.)

XII. METHODS OF COAL MINING. *Lectures.*

Credit two hours.

In this course are taught the systems of developing and excavating coal deposits. Slope, tunnel, and shaft entrances are compared. The dip of beds, the kinds of roof and floor formations, cleavage, drainage, haulage, and ventilation are all considered in connection with the planning of coal mine workings. Driving and sinking through rocks and coal, and the single and multiple entry systems are taken up. Advancing and retreating as applied to longwall, room-and-pillar, and panel systems of mining; the ways of turning, widening, and driving rooms and crosscuts; and the drawing of pillars in thin, thick, flat, rolling, and steep beds of anthracite and bituminous coal are prominent features of this course. Then follow the mining of very thick or contiguous seams; calculations for the position and size of various kinds of pillar; the duties of a coal mine surveyor; the working of ground and surface subsidence; culm flushing; the planning of shaft and slope bottoms.

Prerequisite: Course XI.

Two hours per week during the second semester of the Junior year.

Required in Group II. (A. C. Smith.)

XIII. PRACTICES OF COAL MINING. *Lectures.*

Credit two hours.

The supporting of shafts, slopes, stations, entries, and rooms by the use of wood; the adaptations of steel and concrete for the same purpose; and the maintenance of air courses and roadways through heaving floors and heavy roofs are some of the topics presented under the head of coal mine timbering. The special features of hoisting and drainage particularly applicable to coal mining are here studied contemporaneously with the more general discussions given in Course IX. Under the head of coal mine ventilation, the following are given: the kinds, properties, origin, effects, and detection of coal mine gases; natural means of ventilation, and the use of simple devices; the fresh air requirements of men and animals as influenced by the amounts of obnoxious gases, natural earth temperatures, and barometric pressures; the laws of circulating air currents; the splitting and control of air by sollars, bridges, casts, doors, brattices, and stoppings; the construction and usefulness of safety lamps; systematic inspection of coal mines; reasons for the reversal of ventilation; the care and stabling of mine animals; spontaneous fires; gas and dust explosions; accidents from roof falls; and first aid measures.

Prerequisite: Completed work of the Freshman and Sophomore years.
Course XII.

Two hours per week during the first semester of the Senior year.

Required in Group II.

(Hoskin.)

XIV. COAL MINING EQUIPMENT. *Lectures.*

Credit two hours.

Among the subjects covered by this course are: the construction, cost, use, and operation of the various types of coal-cutting machines, such as punchers, post punchers, shearing machines, and bar, disc and chain cutters operated by compressed air and electricity; the types and construction of pit cars; mechanical devices for loading coal into pit cars; underground equipment for endless rope, tail rope, and gravity haulage; the design, installation and housing of mine fans; head-frames and tipple-houses; car tipples; automatic cages; bar, revolving, and shaking screens; automatic weighing devices; railroad track scales; compressed air and electric box-car loaders; provisions for supplying wagon trade. The course concludes with lectures upon the coal mines which are visited on the Senior Trip.

Prerequisite: Course XIII.

Two hours per week during the second semester of the Senior year.

Required in Group II.

(Hoskin.)

XV. MINE EXAMINATIONS AND REPORTS. *Lectures.*

Credit one hour.

This course covers: the theories relative to scientific sampling of ore bodies; the practices of prominent mining engineers throughout the world; the calculations of ore reserves in tonnage and gross value;

the percentage of ore recoverable; the probable cost of converting reserves into revenue; the technical knowledge, experience, and labor involved in sampling; the precautions that are necessary; inferences to be drawn from erratic samples; the desirability of applying modifying factors to calculated results; discrepancies that are liable to occur between sampling results and subsequent production; the various aspects of mine valuation; the materials to be embodied in and the preparation of reports; the ethics and remunerations of examining engineers.. Each student is furnished printed outlines suggesting points that he should observe during his professional examination of a mining property so that he may render a satisfactory report.

Prerequisite: Completed work of the Freshman and Sophomore years.
Course VI.
Text: Rickard, *The Sampling and Estimation of Ore in a Mine.*

One hour per week during the first semester of the Senior year.

Required in Groups I., II., and IV.

(Hoskin.)

XVI. ECONOMICS OF METAL MINING. *Lectures.*

Credit two hours.

Among the topics discussed in this course are: the considerations that should precede the opening of mines, such as topography, labor, and political conditions, sufficiency of title, climate, transportation facilities, forest reserve or other regulations, and sources of supplies; the acquisition of mining ground under the laws of different nations; incorporation and capitalization; the promotion of exploration and mining companies; investments in mines and mining stocks; fraudulent practices; reasons, other than fraud, for failures in mining; mine administration and superintendence; mine accounting; the leasing system; ore contracts and settlements; details of costs for operation, maintenance, depreciation, and amortization. After considering the general topics, the course goes into the particulars of mining costs as exhibited in the practices of large companies producing base and precious metals.

Prerequisites: Course XV.
Text: Finlay, *Cost of Mining.*

Two hours per week during the second semester of the Senior year.

Required in Groups I., II., and IV.

(Hoskin.)

XVII. MINING LABORATORY.

Credit one-half hour.

The work in this course is done about three-quarters of a mile from the campus at a point on the slope of Mt. Zion, where the

School has built and equipped a mine shop and has started a 7 by 8-foot adit. The shop contains a complete equipment of mining tools for blacksmithing, timbering, track-laying, piping, and repair work of all kinds. It also contains all of the rock drills, mine cars, and other apparatus used in the underground work. The students work in squads of three or four and perform all of the usual duties attending the driving of a tunnel, such as track-laying, timbering, drilling with air and electric machines, blasting, mucking, and tramming. Under the instruction of a practical miner, the students learn to sharpen and temper their own steels for the varying conditions of ground and for the several makes of drills. Opportunity is afforded students to do extra work along the line of investigating, the efficiency and power consumption of various makes of drills, and the relative properties of various brands of high explosives.

Prerequisites: Completed work of the Freshman and Sophomore years.
Completion of, or enrolment in, Course IX.

A minimum of seven half-days during the first semester of the Senior year.

Required in Groups I. and II.

(Hoskin, Smith.)

XVIII. ECONOMICS OF COAL MINING. *Lectures.*

Credit one hour.

The topics covered by this course are those having a direct bearing upon the success or failure of coal mining ventures. Advantage is taken of the fact that this course is given contemporaneously with Course XVI., which includes features common to all kinds of mining. Hence this course does not deal with generalities in mining economics but discusses only such subjects as the methods of acquiring coal lands from individuals and governments; the inefficiency of past mining methods; relative efficiency of hand and machine work; power used in coal mining; the market and trade conditions; legal inspection of coal mines; investigations concerning gas and dust explosions; other coal mine accidents; "first aid" measures; wage versus contract systems; the treatment of employees; the issuance of supplies; company charges for insurance and physicians; check weighmen; the approximate cost of each operation in mining; fixed charges; average prices of coal at the mines; the complement and duties of mine officials and engineers; company liabilities; the disposal of unsalable products; provisions for supplying local trade about mines; the permissible degree of secrecy to be maintained concerning maps and records.

Prerequisites: Course XIII.
Completion of, or enrolment in, Course XVI.

One hour per week during the second semester of the Senior year.

Required in Course II. (Hoskin).

METALLURGY.

Professor Frank Weiss Traphagen.
Assistant Professor William George Haldane.
Fellow Robert Mayro Keeney.

I. ASSAYING. *Lectures and Laboratory.*

Credit three hours.

Special attention is directed toward making this course as practical as possible. Although the importance of accurate work is at no time lost sight of, constant efforts are made to enable the student to handle a large amount of work in as short a time as possible. As nearly as may be, the student is put under smeltery conditions, and is early made familiar with the system prevailing in the best conducted laboratories, so that in the end he may be able to take his place at once in such a laboratory without undergoing a "breaking-in" course after leaving school. The work includes the usual assays called for in the laboratory of mine, mill, or smeltery, and the methods, besides those in use so satisfactorily for many years, include also such "short cuts" as have been introduced by assayers who have several hundred assays to make daily. The course covers the following: the fusibility of slags of definite composition made up by careful calculation; the fluxing of limestone ores and silicious ores for practice; the running of lead mixtures of known lead, silica and base content to determine the influence of foreign elements and variable gauge; the assays of sulphide and oxide ores of lead; the assay of gold and silver ores of different types by various methods, with a comparison of results; the assay of zinciferous and cupriferous gold and silver ores; of arsenical and antimonial ores; and the crucible and scorification assay of mattes and concentrates.

Prerequisites: Completed work of the Freshman and Sophomore years.

Reference: Fulton, *A Manual of Fire Assaying.*

One hour lecture, six hours laboratory, for one semester.

Required in Groups I., II., and IV. It may be taken in either semester of the Junior year.

(Traphagen, Haldane, Keeney.)

II. ASSAYING. *Lectures and Laboratory.*

Credit four hours.

In addition to the work outlined in Course I. all the products that the assayer may be called upon to handle are discussed. These include: blister anode, and cathode copper; tin and platinum ores; cyanide solutions, slime, and products; zinc retort residues; base, gold, and silver bullion. The latter is assayed by the fire and also by the Volhard and Gay-Lussac methods.

Prerequisites: Completed work of the Freshman and Sophomore years.

References: Fulton, *A Manual of Fire Assaying.*
Ricketts and Miller, *Notes on Assaying.*
Lodge, *Notes on Assaying.*

One hour lecture, nine hours laboratory, during the first semester of the Junior year.

Required in Group III.

(Traphagen, Haldane, Keeney.)

III. METALLURGY. *Lectures.*

Credit three hours.

The subjects included in this course comprise an extension of the work on fuels, involving the calculation of air required for combustion, weight of the products of combustion, heat carried away by flue gases, the heat value of various solid, liquid, and gaseous fuels; pyrometry and the modern methods of high temperature measurements; calorimetry and the various means of determining the calorific power of fuels; the fundamental metallurgical principles; and a study of the different types of metallurgical furnaces and their applications.

Iron and Steel. On account of the marked development in the metallurgy of iron, the general application of labor-saving devices, and the basal metallurgical principles involved in its production, this subject is considered first. Pig iron manufacture, with a study of the blast furnace and its accessories; the chemistry of the blast furnace; the utilization of furnace gases; the calculation of charges; the puddling process for wrought iron; the manufacture of steel by the Bessemer, open hearth, cementation, and crucible processes, with a consideration of the reactions involved; and the various furnaces and applications incident to a modern plant are taken up in logical order.

Prerequisites: Completed work of the Freshman year.
Physics I. to IV., inclusive.
Chemistry, X. and XII.

References: Richards, *Metallurgical Calculations.*
Greenwood, *Iron and Steel.*
Stoughton, *Iron and Steel.*

Three hours per week during the first semester of the Junior year.

Required in Groups I., II., III., and IV.

(Haldane.)

IV. METALLURGY. *Lectures.*

Credit three hours.

Lead. The metallurgy of lead is considered in the following order: properties of lead and its compounds; ores of lead; sampling and purchasing of lead ores; fluxes and fuel; reverberatory smelting; smelting in the ore hearth; roasting of ores, including the chemistry of the roasting process; blast furnace smelting, including construction, chemistry of the blast furnace, calculation of furnace charges, treatment of products; softening, desilverization, and refining of base bullion; Pattinson process; Parkes process; German and English cupellation.

Antimony. This metal is so closely allied to lead that its metallurgy very properly follows the latter. The extraction of the metal from its ores and the refining of the product by present methods are discussed at length; considerable attention is given to the common antimonial alloys and furnace products in which this metal is found.

Prerequisite: Course III.

Reference: Hoffman, *Metallurgy of Lead.*

Three hours per week during the second semester of the Junior year.

Required in Groups I., II., III., and IV.

(Haldane.)

V. METALLURGY. *Lectures.*

Credit two hours.

This is an extension of Course III. and involves additional work in the study of the heat balance, blast furnace design, and a closer consideration of the details in the various methods of steel manufacture.

Prerequisites: Completed work of the Freshman year.
Chemistry, X. and XII.
Physics, I. to IV., inclusive.

Two hours per week during the first semester of the Junior year.

Required in Group III.

(Haldane.)

VI. METALLURGY. *Lectures.*

Credit two hours.

Bismuth. The several processes for the extraction of bismuth from its ores and metallurgical products are dealt with in detail, together with the approved methods of refining the product.

Zinc. The following topics are considered: calcination; roasting and distillation by various methods, with a detailed study of furnace types, direct fired, semi-gas and gas fired; manufacture of retorts; refining of spelter and general cost of production.

Cadmium. The lectures on this topic deal with the subject as follows: source of ores; wet and dry extraction; electrolytic methods.

Prerequisite: Course V.

References: Ingalls, *Metallurgy of Zinc and Cadmium.*
Schnabel, *Handbook of Metallurgy.*

Two hours per week during the second semester of the Junior year.

Required in Group III.

(Haldane.)

VII. ORE DRESSING. *Lectures.*

Credit four hours.

The following represent the main divisions under which this subject is studied; jaw and gyratory breakers; rolls; gravity, steam, and pneumatic stamps; special crushing and fine grinding apparatus; apparatus for sizing, including the various types of screens and classifiers; concentrating machines, including jigs, tables and vanners; dry, magnetic, electrostatic, and surface tension concentration; coal washing and the design of plants.

Prerequisites: Completed work of the Freshman and Sophomore years.

Four hours per week during the first semester of the Senior year.

Required in Groups I., II., III., and IV.

(Traphagen.)

VIII. ORE DRESSING. *Laboratory.*

Credit one hour.

The work consists of sizing tests of the products of various crushers and operations; slime settling; determinations of free settling rates; concentrating by panning and by various mechanical devices; and comparative studies of the different forms of commercial sizing, classifying, and concentrating devices.

Prerequisites: Completed work of the Freshman and Sophomore years.
Metallurgy I. or II.

This must be taken subsequent to, or in conjunction with, Course VII.

Three hours per week during the first semester of the Senior year.

Required in Groups I., II., III., and IV.

(Traphagen, Keeney.)

IX. METALLURGY. *Lectures.*

Credit three hours.

Mercury and Other Metals. This work includes a series of lectures on the properties and metallurgy of mercury, tin, nickel, cobalt, and other metals not treated elsewhere, with a general discussion of the principles of treatment and of the best current practice.

SEMINAR. Weekly meetings are held for the consideration of current journal articles on metallurgy, the discussion of thesis work, and practice in the abstracting of papers.

ADMINISTRATION. A series of lectures covers the various practices followed in the division of the work of plants and the handling of men, together with a study of the systems of keeping accounts and of reporting results.

Prerequisites: Completed work of the Freshman and Sophomore years.
Metallurgy I. or II., and IV.

Reference: Schnabel, *Handbook of Metallurgy.*

Three hours lecture, and Seminar work, during the first semester of the Senior year.

Required in Group III.

(Traphagen.)

X. METALLURGY. *Laboratory.*

Credit one hour.

This course is intended to supplement the lecture work of the Junior year and includes work with optical and electrical pyrometers; heat value of solid, liquid, and gaseous fuels by the Junker, Parr, and Bomb calorimeters; heat treatment of steel; the thermit process and the desilverization of base bullion.

Prerequisites: Completed work of the Freshman and Sophomore years.
Metallurgy I. or II., and IV.

References: Howe, *Metallurgical Laboratory Notes.*
Sauveur and Boylston, *Laboratory Experiments in Metallurgy.*

Three hours per week during the first semester of the Senior year.
Required in Group III.

(Haldane.)

XI. METALLURGY. *Lectures.*

Credit four hours.

GOLD AND SILVER. This course covers the following: metallurgy of gold and silver with special attention to stamp milling, cyanidation, and chlorination of gold ores; chloridizing roasting, and amalgamation of silver ores; the Russell process and other wet methods for silver; the parting of gold and silver bullion by various commercial methods, with special attention to electrolysis and the sulphuric acid treatment. The various modifications of the cyanide process receive particular attention, especially the treatment of the slimes for zinc precipitation; the Moore filter process; the regeneration of the cyanide; the different methods proposed for precipitating the dissolved gold and the recent application of the cyanide process to silver ores.

Copper. A critical study of the principles of copper metallurgy as covered by the best modern practice, together with the roasting of ores, blast and reverberatory smelting, pyritic smelting, converting of matte, refining of copper, treatment of oxidized ores, and hydrometallurgical methods.

Prerequisites: Completed work of the Freshman and Sophomore years.
Metallurgy I. or II., and IV.

References: Rickard, *Stamp Milling of Gold Ores.*
Park, *The Cyanide Process.*
Julian and Smart, *The Cyanide Industry.*
Peters, *Modern Copper Smelting.*
Peters, *Principles of Copper Smelting.*

Four hours lecture per week during the second semester of the Senior year.

Required in Groups I., III., and IV.

(Traphagen.)

XII. METALLURGY. *Laboratory.*

Credit one hour.

This work includes the testing of gold ores by amalgamation, chlorination, and cyanidation; chloridizing roasting and amalgamation of silver ores; roasting and smelting of copper ores and products; tests of complex ores by dry chlorination, and other methods, and the laboratory study of such processes as lend themselves to small scale treatment.

Prerequisites: Completed work of the Freshman and Sophomore years.
Metallurgy I. or II., and IV.

Three hours laboratory per week during the second semester of the Senior year.

Required in Group III.

(Traphagen, Keeney.)

XIII. METALLOGRAPHY. *Lectures and Laboratory.*

Credit two hours.

This course comprises a study of the general methods of investigating metals and alloys; the experimental determination and plotting of cooling curves; the physical mixture, including a consideration of aqueous solutions, fused salts and alloys; a discussion of freezing point curves and diagrams; the preparation of the sample and development of the structure by various etching media; the use of the microscope and methods of making microphotographs. Following a study of the constitution and microstructure of iron and steel and the industrial alloys as influenced by heat treatment, considerable time is spent in the investigation of mattes speisses, bullions, and other metallurgical furnace products.

Prerequisites: Completed work of the Freshman and Sophomore years.
Course IV.

References: Goerens, *An Introduction to Metallography.*
Ruer, *Elements of Metallography.*

One hour lecture during the first semester, and three hours laboratory during the second semester, of the Senior year.

Required in Group III.

(Haldane.)

XIV. ELECTROMETALLURGY. *Lectures and Laboratory.*

Credit three hours.

This course is divided into two parts and covers the following subjects:

1. The phenomena of electrolysis.
    - (a) Measurement of the resistance and conductivities of electrolytes.
      Liquid and fused electrolytes.
    - (b) Temperature effects.

  Osmosis.
    The principles underlying the transformation of electrical and chemical energy.
    - (a) Electromotive forces and heats of combinations.
    - (b) Thermo-electromotive effects.

  Principles of electrical heating.
    - (a) Conduction and radiation.
    - (b) Efficiency of transformation of electrical energy into heat.

Lectures two hours, laboratory three hours, per week for the first nine weeks of the first semester of the Senior year.

(Miller.)

2. The estimation of the metals; copper, mercury, silver, zinc, tin, antimony, arsenic, lead, and the separation of metals.

Lectures two hours, laboratory three hours, per week during the last nine weeks of the first semester of the Senior year.

(Test.)

Prerequisites: Completed work of the Freshman and Sophomore years.
Course IV.

Required in Group III.

XV. ELECTROMETALLURGY. *Lectures.*

Credit two hours.

This course is divided into two parts and covers the following subjects:

(a) The electrolytic treatment and refining of metals and the parting of gold and silver bullion.

(b) Electric furnace.

This is a course of lectures and recitations on modern practice in electric smelting, in which the various types of furnaces and their underlying principles are discussed and comparisons made with ordinary fire methods, followed by the direct application to the reduction of metals, the manufacture of carbide, carborundum, graphite, and other products.

Prerequisite: Course XIV.

Two hours per week during the second semester of the Senior year.

Required in Group III.

(Traphagen, Haldane.)

XVI. METALLURGICAL PRACTICE.

This course covers the operation of commercial size machines of the various types used in practical metallurgy, including crushing and concentration, stamp milling, roasting and smelting of ores, cyanide and chlorination practice.

Prerequisites: Courses I. or II., III., IV., VII., and VIII.

Required in Groups I., II., III., and IV.

(Traphagen, Haldane, Keeney.)

This work is given during the week preceding the Senior Trip.

XVII. ADVANCED GENERAL METALLURGY. (Postgraduate.)

Lectures and Laboratory.

Credit two hours.

This course comprises a study of metallurgical processes in the light of a good fundamental knowledge of the subject, with the object of gaining a thorough grasp of the underlying principles of metallurgical science. It covers the following subjects: slag and slag formations suitable to different processes, their chemical properties, formation temperatures, melting points, and other properties; a detailed study of the metallurgy of copper, with particular reference to pyritic smelting and converting of copper matte; advanced work in the metallurgy of the precious metals, with special attention to ores difficult of treatment and to the use of recovery methods in the cyanide process.

One hour lecture, and three hours laboratory, per week with assigned reading during the second semester.

This course is intended primarily for postgraduates but may be taken by undergraduates with the consent of the instructor.

(Traphagen.)

XVIII. ADVANCED METALLOGRAPHY. (Postgraduate,) *Lectures and Laboratory.*

Credit two hours.

This course is an extension of Course XIII. and involves a more thorough investigation of the theory of cooling curves and metallic alloys, after which some attention is given to the ternary alloys. The student is then given some individual problems to investigate.

Prerequisite: Course XIII.

One hour lecture, three hours laboratory, per week during the first semester.

This course is intended primarily for postgraduates but may be taken by undergraduates with the consent of the instructor.

(Haldane.)

GEOLOGY AND MINERALOGY.

Professor Horace Bushnell Patton.
Assistant Professor G. Montague Butler.
Assistant Professor Charles Edward Smith.
Assistant Charles David Heaton.

The college is very fortunately situated for the geologist. The surrounding formations not only present the strikingly clear features so characteristic of the West, but occur in great profusion and variety. In addition certain features peculiar to this particular location afford sufficiently complicated problems to be of great value to the student of geology. It is possible, therefore, without going more than a mile or two from the school to illustrate very effectively most geological problems so that field geology can be carried on at the same time with class instruction.

I GENERAL GEOLOGY. *Lectures.*

This course, together with Course II., is intended for beginners, and yet is made full enough to satisfy the requirements of students who may elect courses of study in which a greater familiarity with general geology is not imperative. It discusses general geological principles in connection with dynamical, structural, physiographic, and historical geology. A number of field trips to near-by points are required for the purpose of emphasizing the importance of scientific observation. The attention of the class is called to the processes now active and to the structures which have resulted from former dynamical activities. Neatly written reports of these trips are required after the different subjects illustrated by the trip have been treated in regular lectures. It is essentially a lecture course, though it is expected that each student shall possess a good text of contemporaneous reading.

Prerequisites: Entrance requirements.

Text: Chamberlin and Salisbury, *College Geology.*

Three hours per week during the first semester of the Freshman year.

Required of all students.

(C. E. Smith.)

II. GENERAL GEOLOGY. *Lectures.*

This is a continuation of Course I.

Prerequisite: Course I.

Text: Chamberlin and Salisbury, *College Geology.*

Three hours per week during the second semester of the Freshman year.

Required of all students.

(C. E. Smith.)

III. CRYSTALLOGRAPHY. *Lectures and Laboratory.*

This course is treated as an essential part of the general work in mineralogy. Only such portions of the subject are especially emphasized as are of practical value in the determination and proper understanding of minerals. A very thorough drill, however, is given in the more practical portions of the subject. This course is presented through lectures, text books, and practical laboratory work; also by individual quizzes. In connection with the laboratory work each student is required to become thoroughly familiar with crystal forms and combination such as are found on the usual wooden crystal models, and to determine with the aid of a pocket lens and contact goniometer the crystal forms of three hundred crystals.

Prerequisites: Chemistry I. to VI., inclusive.

Text: Patton, *Lecture Notes on Crystallography.*

Lecture two hours, laboratory six hours, per week during the first eleven weeks of the Sophomore year.

Required of all students.

(Patton, Butler, C. E. Smith, Heaton.)

IV. MINERALOGY. *Lectures and Laboratory.*

This course begins about the end of November with a drill for four weeks in the methods of blowpipe analysis, with a view to preparing the student for the practical determination of minerals. This is followed by determinative mineralogy, which continues until the close of the second semester of the Sophomore year. About two hundred and fifty of the most important mineral species are presented by lecture, in which special emphasis is laid on the recognition of minerals by means of their physical properties and crystal forms. The object constantly kept in mind is not the training that will enable one to determine any mineral whatever,but rather to recognize at sight such minerals as are likely to be met in connection with mining operations. This is what the average mining engineer is expected to do. With this object in view, as thorough a drill as the time will allow is given to the actual handling and determining of minerals in the laboratory. In this work each student is expected to handle, to determine, and to be questioned and examined on approximately two thousand five hundred individual specimens.

Prerequisite: Course III.

Text: Butler, *Pocket Handbook of Blowpipe Analysis.*
Butler, *Pocket Handbook of Minerals.*

Lecture two hours, laboratory six hours, per week beginning about the end of November and continuing to the close of the second semester of the Sophomore year.

Required of all students.

(Butler, Patton, C. E. Smith, Heaton.)

V. ADVANCED GEOLOGY. *Lectures.*

Credit five hours.

It is the object of this course to train the student in the interpretation of geological phenomena and in the reading of earth history. No time is spent upon the more theoretical aspects of the science, such as are involved in physiographic and dynamic geology, but the practical application of the facts of stratigraphical and structural geology are emphasized. An outline of historical geology, with special reference to American areas, is presented, in which stress is placed upon the epeirogenic and orogenic movements, the economic products, the life systems, and the character of the rocks of the various geological time divisions. An effort is also made so to familiarize the student with the more important varieties of fossils that he may determine the age of any fossiliferous area. The work is given by means of lectures, laboratory work on fossils, and field trips.

Prerequisites: Completed work of the Freshman year.

Five hours per week during the first semester of the Junior year.

Required in Group IV.

(Butler.)

VI. LITHOLOGY. *Lectures and Laboratory.*

Credit three hours.

This is a lecture course supplemented by laboratory work. The object is to present all the more commonly occurring rocks in such a way as to render their identification at sight reasonably accurate. The methods pursued are purely those applicable to the hand specimen without the aid of microscopic sections. The collection of the school is especially rich in those rocks that are usually encountered in mining operations in Colorado and adjacent states. Special emphasis, therefore, is laid upon such rocks and upon their various alteration forms.

Prerequisites: Completed work of the Freshman year.
Course IV.

Text: Kemp, *Handbook of Rocks.*

Lecture two hours, laboratory three hours, per week during the second semester of the Junior year.

Required in Groups I. and IV.

(Patton, Butler, C. E. Smith, Heaton.)

VII. FIELD GEOLOGY.

Credit three hours.

This course is designed to give a student practice in the various processes involved in preparing a complete geological map. The work covered includes, first, the preparation of a complete topographic map, including triangulation and contouring; second, the working out and mapping of the areal geology; third, the study of the economic features such as ore deposits that may be found on the territory surveyed. The area selected for study and mapping is usually some mining district in Colorado that has not been already mapped and surveyed. The methods used in the preparation of the topographic map are mostly those that admit of rapid work and a degree of accuracy sufficient for most practical purposes.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses V., and VI.

Six weeks during the summer between the Junior and Senior years and after the close of Mining, Course III.

Required of Group IV.

(Patton, C. E. Smith, Butler, Heaton.)

VIII. FIELD GEOLOGY.

This is a briefer course than Course VII. and is intended to give practice in the use of geological instruments and some practical familiarity with methods of topographic and geologic mapping, as well as to train the student in correct geological observation.

Prerequisites: Completed work of the Freshman and Sophomore years.

Six days during the first week of the Senior year.

Required in Groups I. and II.

(Patton, Butler, C. E. Smith, Heaton.)

IX. MICROSCOPIC PETROGRAPHY. *Lectures and Laboratory.*

Credit three hours.

In this course the study of rocks and rock-forming minerals is carried on with the help of the petrographic microscope. It covers (a) the study of the optical properties of minerals with a view to their identification, and (b) systematic petrography or the identification of rock types by means of their structures and mineral components.

Prerequisites: Completed work of the Freshman and Sophomore years.
Course VI.

Lecture and laboratory work six hours per week during the first semester of the Senior year.

Required in Group IV.

(Patton.)

X. ORE DEPOSITS. *Lectures.*

Credit three hours.

This course treats of the nature, origin, and occurrence of ore deposits. Special attention is given to the ores carrying the more valuable metals and iron, and to the more important mining camps of the west. The work is carried on principally by lectures with the aid of a text book.

Prerequisites: Completed work of the Freshman and Sophomore years.
Course VI.

Text: Ries, *Economic Geology.*

Lectures three hours per week during the first semester of the Senior year.

Required in Groups I. and IV.

(Patton.)

XI. ECONOMIC GEOLOGY. *Lectures.*

Credit three hours.

This is a continuation of Course X. but takes up, in addition to a further discussion of metallic ore deposits, the more important non-metallic products and their sources.

Prerequisite: Course X.

Text: Ries, *Economic Geology.*

Lecture three hours per week during the second semester of the Senior year.

Required in Groups I., and IV.

(Patton.)

XII. MINING GEOLOGY. *Lectures.*

Credit three hours.

This course aims to give the student the knowledge required for the solution of the many puzzling geological problems that confront mining engineers. Among the subjects discussed are the following: characteristics of the various types of ore deposits; criteria governing changes in the grade or character of the ore, both in vertical and horizontal directions; factors governing the vertical and horizontal extension of ore bodies; irregularities produced by faulting; folding, or the intrusion of igneous rocks; geology and physiography as an aid in prospecting. The features described are illustrated by many carefully chosen examples. The student is required to solve scores of practical problems by the application of the principles enunciated.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses V., VI., and X.

Lecture three hours per week during the second semester of the Senior year.

Required in Group IV.

(Butler.)

XIII. GEMS AND GEM MINING. (Postgraduate) *Lectures.*

Credit two hours.

This course is intended to give the student a proper realization of the economic importance of the gem industry and the knowledge required to turn this appreciation to practical account. Among the more important subjects discussed are the following: the recognition and valuation, the cost and manner of cutting and mounting, the geographical distribution, the geological occurrence, and the manner of mining or collecting all grades of precious and semi-precious stones. In addition to the lecture and laboratory work, several trips are taken to the shops of Denver jewelers and lapidaries for work on the very valuable species, and to study the cutting and polishing of gems.

Lectures two hours, laboratory one hour, per week during the first semester.

This course is intended primarily for postgraduates but may be taken by undergraduates with the consent of the instructor.

(Butler.)

XIV. CERAMIC GEOLOGY. (Postgraduate.) *Lectures, laboratory, and field work.*

Credit one hour.

This course is intended to enable the student to find, to classify properly, and to quarry or mine the raw materials of the ceramic art. Emphasis is placed upon the geology of the subject rather than upon the details of manufacture of the clay products. Only the peculiar features and requirements of each line of manufacture are presented. The following subjects are discussed: the classification of clays and allied substances; their physical character, their recognition in the field, and their distinctive properties; the necessary tests and chemical distinctions; the geological and geographical distribution of clays; the nature and cost of mining and quarrying operations; the value of, and market for, the various varieties; the uses of clays and the manufacture of clay products; securing government title to clay land; examining and reporting upon clay deposits.

Lectures, laboratory, and field work three hours per week during the second semester.

This course is intended primarily for postgraduates but may be taken by undergraduates with the consent of the instructor.

(Butler.)

XV. GLACIAL GEOLOGY. (Postgraduate). *Lectures.*

Credit one hour.

In this course will be given, first, a general discussion of glacial phenomena; second, a more specific discussion of continental ice sheets and deposits, and the ice age in North America; third, a specific discussion of Alpine glaciers and their deposits as illustrated in the Rocky Mountain region.

Lecture one hour per week during the first semester.

This course is intended primarily for postgraduates but may be taken by undergraduates with the consent of the instructor.

(C. E. Smith.)

CIVIL ENGINEERING.

Professor William Franklin Allison.
Professor William Jonathan Hazard.
Instructor Harry Munson Showman.

The aim of this department is to develop the student along such lines in civil engineering as may be required of a mining engineer. This includes some knowledge of plane surveying, structural mechanics, structural design, hydraulics, and hydraulic design.

I. PLANE SURVEYING. *Lectures and Field Work.*

Instruction is given by lectures, recitations, and field practice in the use and care of surveyor's instruments of precision. This work includes the adjustment of instruments; the theory and use of the barometer, planimeter, and plane-table; the principles and practice of land, city, topographical, and railroad surveying; and the determination of a meridian by observation on the sun and on circumpolar stars.

Prerequisites: Mathematics I. and II.
Mechanical Engineering I. and II.

This course is not intended for students below the Sophomore class.

Texts: Raymond, *Plane Surveying.*
Searles, *Field Engineering.*

The entire work of this course is done during the six weeks following the close of the Sophomore year.

Required of all students.

(Allison, Showman.)

II. MECHANICS OF ENGINEERING. *Lectures.*

Credit five hours.

This course consists of the theoretical study of mechanism and materials, embracing statics of a material point and of rigid bodies; chains, cords and cables; stresses and strains; tension, shearing, compression; torsion, flexure; combined torsion and flexure; elastic curves; safe loads; oblique forces; long columns and continuous beams. The student becomes familiar with the fundamental ideas of the motions of bodies, initially treating the dynamics of a material point, with extensions of the theory to finite bodies. The fundamental differential equations of rectilinear motion are developed, and practical applications are found in the case of falling bodies, upward throw, and uniformly and variably accelerated bodies. Newton's laws are the basis of these latter items and also of the hypothetical "Engineers' Mass."

Prerequisites: Mathematics I. to VI., inclusive.
Completed work of the Freshman year.

Text: Church, *Mechanics of Engineering.*
Church, *Notes and Examples in Mechanics.*

Five hours per week during the first semester of the Junior year.

Required in Groups I., II., III., and IV.

(Allison.)

III. MECHANICS OF ENGINEERING. *Lectures.*

Credit five hours.

This is an extension of Course II. Virtual velocities introduce the first elements of the principles of work and energy and serve as a basis of discussion in the treatment of the curvilinear motion of a material point which follows. Under this latter head the general equations and principles of curvilinear motion are derived and then applied to simple and cycloidal pendulums, to planetary motion, to a projectile in vacuo, to a body on smooth curved guide, and to absolute and relative velocities. A study of rotating bodies, compound pendulums, rudimentary engines, fly-wheels, eccentric pulleys, rolling bodies, parallel rod of locomotives, hoisting in mines, and the like, is made.

Prerequisite: Course II.

Five hours per week during the second semester of the Junior year.

Required in Groups I., II., III., and IV.

(Allison.)

IV. MECHANICS OF ENGINEERING. *Laboratory.*

Credit one hour.

In this course tests are made to determine the strength and stiffness of building materials such as cast-iron, wrought-iron, steel, plain and reinforced concrete, and wood in tension, compression, shearing, and flexure. Stone and brick are examined for strength, absorption, disintegration, and other qualities which decide their economic values. Tests of cement are made as specified by the American Society for Testing Materials.

Prerequisite: This course must be taken in conjunction with
Course III.

Three hours per week during the second semester of the Junior year.

Required in Groups I. and II.

(Hazard.)

V. HYDRAULICS. *Lectures.*

Credit two hours.

The course deals with the theory and practical application of the properties of fluids at rest and in motion, embracing hydrostatic pressure, manometers, strength of pipes, pressures in tanks and against walls and dams; immersion and flotation; steady flow of liquids through pipes and orifices and over weirs; fluid friction and losses of head; time of emptying vessels; steady flow of water in open channels; impulse and resistance of fluids; pumps and rams; the impulse water motor; overshot, breast, and undershot waterwheels; back water; theorem for flow in a revolving pipe; turbine and reaction wheels; and theory of turbine testing.

Prerequisites: Completed work of the Freshman and Sophomore years.
Course III.

Text: Church: *Mechanics of Engineering.*
Church, *Hydraulic Motors.*

Two hours per week during the second semester of the Senior year.

Required in Group I.

(Allison.)

VI. HYDRAULICS. *Laboratory.*

Credit one hour.

Measurements are made of the flow over weirs, through orifices and through flumes and ditches. The determination of the approximate law of flow in pipes also forms part of the course. Waterwheels and centrifugal pumps are tested and the efficiency of the hydraulic ram under various conditions is determined.

Prerequisite: This course can be taken only in conjunction with Course V.

Three hours per week during the second semester of the Senior year.

Required in Group I.

(Hazard.)

VII. ENGINEERING CONSTRUCTION. (Elective.) *Lectures and Drawing.*

Credit four hours.

In this course instruction is given in graphical analysis of the stresses in the more elementary forms of framed structures and a comparison is made with the algebraic solutions of the same problems. The student becomes familiar with the definitions of parts, such as housing, notching, mortise and tenon, dove-tailing, lag-screws, dowels and lugs, and, from accepted unit stresses, he is led to design joints, splices, deepened beams, trussed beams, gallows frames and head frames from wood. A brief study is made of the ordinary timbers used in construction and the best modern methods of protecting them from the action of the elements and wood-destroying insects. Some attention is given to riveted and pin-connected trusses of steel.

Prerequisites: Completed work of the Freshman and Sophomore years.
Course III.

Texts: Ketchum, *Steel Mill Buildings.*
Cambria Steel.
Miscellaneous references.
Lecture notes.

Lectures two hours, drawing six hours, during the first semester of the Senior year.

(Allison, Showman,)

VIII. MILL CONSTRUCTION. (Elective.) *Lectures and Drawing.*

Credit four hours.

This course is a study of the theoretical and practical design of wooden and steel mill buildings and the uses of masonry in connection therewith. The general forms of such buildings are discussed and elementary ideas of ventilation, lighting, coverings, and the like are obtained. A wooden roof truss of accepted pattern is analyzed graphically and a detailed design is completed. Steel mill buildings are thoroughly discussed, an analysis of all stresses involved is obtained and a complete design is required from each student. A suitable amount of time is given to the study of the materials used in masonry construction, such as brick, stone, lime, cement, plain and reinforced concrete.

Prerequisites: Course VII.

Texts: Ketchum, *Steel Mill Buildings.*
Cambria Steel.
Miscellaneous references.
Lecture Notes.

Two hours lectures, six hours drawing, during the second semester of the Senior year.

(Allison, Showman.)

IX. CONTRACTS AND SPECIFICATIONS. (Elective.)

Credit two hours.

This course is given to familiarize the student with the forms and the legality of contracts, together with the parties having power to make them and to carry them out. The student also becomes acquainted with the common forms of specifications. Lectures by members of the legal and technical professions assist the student in more fully understanding the subject.

This course is intended only for regular Seniors but others may take it with the consent of the instructor.

Text: Johnson, *Engineering Contracts and Specifications.*

Two hours per week during the second semester of the Senior year.

(Allison.)

X. ADVANCED MINE AND MILL DESIGN. (Postgraduate.) *Lectures and Drawing.*

This course consists of the design and preparation of detail plans of modern types of mine and mill structures. Special attention is given to the use of steel and reinforced concrete.

Two hours lecture, and six hours drawing, during the first semester.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Allison.)

XI. ADVANCED HYDRAULIC DESIGN. (Postgraduate.) *Lectures and Drawing.*

This course consists of the study of water power development, water supply, and the storage and purification of water, including the design of flumes, conduits, simple and reinforced concrete dams, movable dams, tanks, reservoirs, and filters.

Two hours lecture, and six hours drawing, during the second semester.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Allison.)

MECHANICAL ENGINEERING.

Professor Frank Howard Cronin.
Assistant Professor Robert B. Otis.
Instructor Ransom Smith Hawley.

I. DESCRIPTIVE GEOMETRY. *Lectures.*

This course includes problems relating to the point, line, plane, surfaces, intersections of solids and the development of their surfaces, and numerous practical applications to mine surveying and machine design.

Prerequisites: Entrance requirements.

Text: Church, *Descriptive Geometry.*

Two hours per week during the first semester of the Freshman year.

Required of all students.

(Hawley, Sherwood, Showman.)

II. DESCRIPTIVE GEOMETRY. *Drawing.*

At the beginning of the course considerable time is given to the use of instruments, geometrical constructions, and lettering: then follows the direct application of the problems that are taken up in the lecture work.

Prerequisites: Entrance requirements.

Text: Church, *Descriptive Geometry and Plates.*
Reinhardt, *Lettering.*
Reid, *Mechanical Drawing and Elementary Machine Design.*

Nine hours per week during the first semester of the Freshman year.

Required of all students.

(Hawley, Cronin, Otis.)

III. ELEMENTARY MACHINE DESIGN. *Lectures.*

This course includes a study of machine elements, the nature of materials entering into machine construction, and elementary calculations involving the strength of materials.

Prerequisites: Courses I. and II.

Text: Reid, *Mechanical Drawing and Elementary Machine Design.*

Two hours per week during the second semester of the Freshman year.

Required of all students.

(Cronin, Otis, Hawley.)

IV. ELEMENTARY MACHINE DESIGN. *Drawing.*

The object of this course is to give the student the principles of orthographic projections when applied to machine drawings executed according to modern drafting and shop practice. Considerable time is devoted to correct methods of lettering and dimensioning of drawings and free-hand sketching. Working drawings, made from models, are submitted of the following: anchor-bolts, shaft-couplings, hangers, pipe-joints, valves, and simple engine parts.

Prerequisites: Courses I. and II.

Text: Reid, *Mechanical Drawing and Elementary Machine Design.*

Six hours per week during the second semester of the Freshman year.

Required of all students.

(Hawley, Cronin, Otis.)

V. MACHINE DESIGN. *Lectures.*

This course begins with the theoretical analysis of mechanism and extends to the practical application of these principles to such problems as arise in practice. Special attention is given to the analysis of links, belting, cams, gears, and other contact mechanism.

Prerequisites: Courses III. and IV.

Text: Schwamb and Merrill, *Elements of Mechanism.*

Two hours per week during the first semester of the Sophomore year.

Required of all students.

(Otis, Hawley.)

VI. MACHINE DESIGN. *Drawing.*

This course supplements and is directly dependent upon the lecture work. The work is taken up from a practical point of view and applies such theory as is consistent with the most approved method of design. Designs and complete working drawings are made of machine parts, gears, cams and various systems and devices used for the transmission of power.

Prerequisites: Courses III. and IV.

Text: Schwamb and Merrill, *Elements of Mechanism.*

Three hours per week during the first semester of the Sophomore year.

Required of all students.

(Otis, Hawley.)

VII. MACHINE DESIGN. *Lectures.*

This course is a continuation of Course V. A brief outline of the various principles of mechanics, so necessary for the work, is here taken up. Special attention is given to problems involving the transmission of power and the best solution of these from both the theoretical and practical point of view.

Prerequisites: Courses V. and VI.

Text: Jones, *Machine Design. Part II.*

Two hours per week during the second semester of the Sophomore year.

Required of all students.

(Otis, Hawley.)

VIII. MACHINE DESIGN. *Drawing.*

This course is a continuation of Course VI. The work is extended to include more complex problems. Complete working drawings of some of the following are submitted: shafting layouts: belt, fibrous and wire rope drives; conveyors and conveying systems.

Prerequisites: Courses V. and VI.

Text: Jones, *Machine Design. Part II.*

Three hours per week during the second semester of the Sophomore year.

Required of all students.

(Otis, Hawley.)

IX. STEAM ENGINES AND BOILERS. *Lectures.*

Credit one hour.

The greater portion of the semester is devoted to steam boiler subjects. After a brief historical treatment of the subject, the lectures cover the theory, principles of design, and construction of modern boilers. Numerous practical problems are assigned from time to time so that the student becomes thoroughly familiar with the design and operation of the leading types of boilers.

Prerequisites: Completed work of the Freshman year.
Courses VII. and VIII.

Text: Peabody and Miller, *Steam Boilers.*

One hour per week during the first semester of the Junior year.

Required in Groups I., II., and III.

(Otis.)

X. STEAM ENGINES AND BOILERS. *Drawing.*

Credit two hours in Groups I. and II.

Credit one hour in Group III.

The drafting room work is devoted principally to the design of power plant apparatus and to such other machinery as is usually to be found in a mine plant. Boilers, steam engines, hoists, conveying systems, and mill installations are designed and complete sets of detail working drawings are required in all cases. The value of time is impressed upon the student and all work is done in accordance with the most approved manufacturing methods.

Prerequisites: Courses VII. and VIII.
Completed work of the Freshman year.

Text: Peabody and Miller, *Steam Boilers.*

Six hours per week during the first semester of the Junior year.

Required in Groups I. and II.

Three hours per week during the first semester of the Junior year.

Required in Group III.

(Otis.)

XI. STEAM ENGINES AND BOILERS. *Lectures.*

Credit one hour.

The lectures of this course embrace principally the subject of steam engines. The development of the steam engine is first carefully traced out, after which attention is given to thermodynamics and the fundamental principles which underlie the steam engine. Practical problems are assigned the student and great stress is laid upon all matters pertaining to the economical side of the subject.

Prerequisites: Courses IX. and X.

Text: Ripper, *Steam Engine, Theory, and Practice.*

One hour per week during the second semester of the Junior year.

Required in Groups I., II., and III.

(Otis.)

XII. STEAM ENGINES AND BOILERS. *Drawing.*

Credit two hours in Groups I. and II.

Credit one hour in Group III.

This course is a continuation of Course X. and enables the student to undertake and complete some of the more advanced designs of power plant machinery.

Prerequisites: Courses IX. and X.

Text: Ripper, *Steam Engine, Theory, and Practice.*

Six hours per week during the second semester of the Junior year.

Required in Groups I. and II.

Three hours per week during the second semester of the Junior year.

Required in Group III.

(Otis.)

XIII. COMPRESSED AIR. *Lectures.*

Credit two hours.

This course includes a study of the theory and practice of air compression. At the beginning considerable time is given to the study of such thermodynamics as is necessary to a successful pursuit of the course. After this the work comprises a study of the following principal items: single and multiple stage compression; absorption of heat during compression; transmission of power by compressed air; draining of moisture from pipe lines; reheating; the use of compressed air in motors and the various valve-gears used. A systematic study is made in the class room of the catalogues of one or more of the leading compressor builders.

Prerequisites: Completed work of the Freshman and Sophomore years.
Course XI.

Text: Peele, *Compressed Air.*
Trade Catalogues.

Two hours per week during the first semester of the Senior year.
Required in Groups I. and II.

(Cronin.)

XIV. POWER PLANT DESIGN. *Lectures.*

Credit two hours.

This course includes a detailed study of the units and auxiliaries necessary to a power plant and their various connecting links. After this, problems affecting the type and location of power plants are taken up and then the work is extended to problems involving the best selection and number of units, location and arrangement, connection with auxiliaries, and the necessary housing for equipment. The items of first cost, operating cost, and depreciation are carefully considered.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses XI. and XII.

Text: Gebhardt, *Power Plant Engineering.*

Two hours per week during the first semester of the Senior year.
Required in Groups I. and II.

(Cronin.)

XV. POWER PLANT DESIGN. *Drawing.*

Credit two hours.

The work in this course includes working drawings of some of the power plant equipment taken up and studied in detail in the lecture course. Such problems as the following are assigned: detail of piping systems, including live and exhaust steam, for a certain size plant; foundations for units and auxiliaries; flues and stacks; coal and ash handling machinery.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses XI. and XII.

Texts: Gebhardt, *Power Plant Engineering.*
Trade Catalogues and Blue Prints.

Six hours per week during the first semester of the Senior year. Required in Groups I. and II.

(Cronin.)

XVI. GAS ENGINES. *Lectures.* (Elective.)

Credit two hours.

This course is intended to give the mining engineer a practical working knowledge of the gas engine. The theory and thermodynamics of the gas engine are carefully considered, together with the conditions affecting efficiency and operation. The best types of modern engines together with auxiliary apparatus are taken up and discussed with regard to special features and advantages. Each student is assigned a seminar paper upon some special subject of investigation. At the conclusion of the course these papers are presented before the class. The last two weeks of the course are devoted to practice in operating and running the engines found in the laboratories.

Prerequisites: Completed work of the Freshman and Sophomore years.
Course XI.

Text: Poole, *The Gas Engine.*

Two hours per week during the first semester of the Senior year.

(Otis.)

XVII. PUMPING MACHINERY. *Lectures.* (Elective.)

Credit three hours.

This course comprises a careful study of the principle, design, and operation of all kinds of pumping machinery. Special attention is given to the selection and installation of steam, electric, and compressed air pumps for mine service. Problems involving the calculations of capacity, slip, and duty of pumping engines are assigned to the students. Along with the study of pumping machinery considerable time is devoted to the study of air-lifts.

Prerequisites: Completed work of the Freshman and Sophomore years.
Course XI.

Text: Greene, *Pumping Machinery.*

Three hours per week during the second semester of the Senior year.

(Cronin.)

XVIII. MECHANICAL ENGINEERING. (Elective). *Lectures and Laboratory.*

Credit two hours.

It is the purpose of this course to familiarize the student with the theory and principle of the more important scientific apparatus used in engineering investigation. Much stress is laid upon the importance of accurate observations, correct interpretations of data secured through the use of laboratory equipment, and the correct form of engineering reports based upon the results of laboratory experiments. The work includes the following: steam and gas engine indicator practice; principle and operation of various reducing motions; absorption and transmission dynamometers; determination of the quality of steam; calibration of gages; valve setting; air meters; efficiency tests of steam and gas engines; efficiency and capacity tests of boilers; flue gas analysis; efficiency and capacity tests of air compressors; efficiency and capacity tests of small steam turbines.

Prerequisites: Completed work of the Freshman and Sophomore years.
Course XI.

Text: Carpenter, *Experimental Engineering.*

One hour lecture, and three hours laboratory, per week during the second semester of the Senior year.

(Cronin.)

XIX. MINE PLANT DESIGN. (Postgraduate.) *Lectures and Drawing.*

Credit four hours.

This work is a continuation of the course in power plants and is extended to cover the design of a power plant for a mine. The work in the lecture room begins with an analysis of the problems affecting the location of a type plant and is extended to an analysis of the various departments of the plant and subsequently to the method of arriving at the power required by each under a particular case. Each student is assigned a problem that includes the design of a power plant for certain character and size of mine. The work on the part of the student comprises complete calculations to determine the best number and size of units to suit the conditions imposed, the selection of machinery, and the layout of the plant. The drawings submitted include sufficient detailed and assembled drawings of the surface and underground plants so that the equipment can be installed. Blue prints of most of the equipment that is necessary for the foregoing work and kept on hand by the department: in the absence of such to suit conditions they are secured from the various manufactures of such apparatus.

Prerequisites: Courses XIV. and XV.

Text: Gebhardt, *Power Plant Engineering.*

This course is intended primarily for postgraduates but may be taken by undergraduates with the consent of the instructor.

Two hours lecture, and six hours drawing, per week during the second semester of the Senior year.

(Cronin.)

XX. METALLURGICAL PLANT DESIGN. (Postgraduate.) *Lectures and Drawing.*

Credit two hours.

This work is a continuation of the work on power plants which is extended to cover the design of a power plant for a concentrating, a cyanide, or a chlorination mill. The work on the part of the student comprises complete calculations to determine the number and size of units to suit the conditions imposed, the selection of machinery, and the layout of the plant. The student has access to many blue prints from manufacturing concerns to facilitate his work. Sufficient detailed and assembled drawings are executed to insure the installation of the plant.

Prerequisites: Courses XI. and XII.
Metallurgy. Courses III., IV., VII., and VIII.

Text: Meyer, *Steam Power Plants.*
Trade Catalogues and blue prints.

One hour lecture, and three hours drawing, per week during the second semester of the Senior year.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Otis.)

XXI. GAS ENGINE DESIGN. (Postgraduate.) *Drawing.*

Credit two hours.

In this course the student is assigned the problem of designing an engine, of either the two or four cycle type, capable of developing a specified horse power when working under certain conditions, depending upon the service, locality, and kind of fuel. The theory and underlying principles of gas engine design are carefully considered and practically applied according to the most approved business methods of manufacture. With the final completion of the general design a set of detail working drawings is made, conforming rigidly to the requirements of the modern shop where cost systems and part lists are in vogue.

Prerequisite: Course XVI.

Text: Lueke, *Gas Engine Design.*

Six hours drawing per week during the first semester.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Otis.)

XXII. COAL TESTING. (Postgraduate.)

Credit one hour.

It is the purpose of this course to give the advanced student the privilege of determining the adaptability and calorific value of the various kinds of coal, found in this and in adjoining states, by actually burning them under a boiler or in a gas producer. The complete and ample equipment at the college affords a special opportunity for carrying on such work.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Cronin.)

XXIII. MINE PLANT TESTING. (Postgraduate.)

Credit two hours.

This course is arranged with the idea of giving the student an opportunity to secure data by engineering methods from actually operating plants. The plants from which data are secured may be those of either coal or precious metal mines, or both. The tests may be conducted upon any one department of the plant or upon the plant as a whole. The work consists for the most part of determining the power used and efficiency of various makes of machinery for hoisting, pumping, air compression, generating electric light and power, conveying, ventilating, and for general shop purposes. The student takes the necessary apparatus in the field, sets it in place, and conducts the test in such a manner and for such a length of time as is necessary to obtain consistent engineering data. In order to carry on the work successfully, the student must be thoroughly familiar with the methods and apparatus used in conducting tests on power plants. The methods used may be summed up briefly as follows: sampling and analyzing coals and gases; sampling and determining quality of steam; indicating reciprocating units; brake horsepower tests; valve setting and metering steam, air, and electrical energy.

The proximity of the college to plants of mining and metallurgical operations affords special opportunities and facilities for carrying on this work.

One hour lecture and three hours laboratory during one semester.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Cronin.)

ELECTRICAL ENGINEERING.

PROFESSOR WILLIAM JONATHAN HAZARD.

I. ELECTRICITY. *Lectures and Laboratory.*

Credit four hours.

This course covers very briefly the principles of direct current machines and the chief applications to mining machinery.

Prerequisites: Completed work of the Freshman and Sophomore years.

Text: Franklin and Esty, *Elements of Electrical Engineering. Direct Currents.*

Three hours lecture, and three hours laboratory, per week during the second semester of the Senior year.

Required in Group II.

(Hazard.)

II. DIRECT CURRENT MACHINERY. (Elective.) *Lectures and Laboratory.*

Credit six hours.

The course is intended to cover as thoroughly as possible the principles and applications of direct current machinery and the design of installations and lines.

Prerequisites: Completed work of the Freshman year.
Physics I. to IV., inclusive.

Text: Sheldon and Hausemann, *Direct Current Machines.*

Four hours lecture, and six hours laboratory, per week during the first semester of the Junior year.

(Hazard.)

III. ALTERNATING CURRENT MACHINERY. (Elective.) *Lectures and Laboratory.*

Credit seven hours.

This is an extension of Course II. and includes the principles of alternating current machinery, the applications of different types of motors, and the construction of alternating current switchboards and lines.

Prerequisites: Completed work of the Freshman year.
Physics I. to IV., inclusive.

Text: Sheldon, Mason, and Hausemann, *Alternate Current Machines.*

Five hours lectures and six hours laboratory, per week during the second semester of the Junior year.

(Hazard.)

IV. SPECIAL APPARATUS AND APPLICATIONS. (Elective.)
Lectures and Laboratory.

Credit three hours.

The course includes technical reading and study of existing plants, a study of automatic controlling apparatus, and tests of installations.

Prerequisites: Completed work of the Freshman and Sophomore years.
Courses II. and III.

Two hours lecture, and three hours laboratory, per week during the first semester of the Senior year.

(Hazard.)

CHEMISTRY.

PROFESSOR HERMAN FLECK.
ASSISTANT PROFESSOR CHARLES DARWIN TEST.
ASSISTANT PROFESSOR JOHN CHRISTIAN BAILAR.
INSTRUCTOR WILLIAM SAMUEL MEDELL.
FELLOW CARL ARLO ROCKWOOD.
ASSISTANT ALBERT THOMAS MERTES.

The courses in Chemistry are arranged especially for the needs of the mining and metallurgical engineer. The demands made upon chemistry by these branches of engineering require a broad knowledge of inorganic chemistry, of the theories underlying the science, and a close acquaintance with the properties of the elements, their reactions, detection, and separation.

I. GENERAL CHEMISTRY. *Lectures.*

The course begins with a historical sketch of the development of the science of chemistry up to the atomic era. Thereafter history is introduced only as occasion demands. Although the course rests on a structure of inorganic chemistry, the development and application of modern theories and of organic chemistry are taught as the work advances through the non-metallic elements during the first semester. Simultaneously a closer inspection of these elements is offered in the laboratory.

Prerequisites: Entrance requirements.

Text: Richter, *Inorganic Chemistry.*

Lectures four hours, recitation one hour, per week during the first semester of the Freshman year.

Required of all students.

(Fleck, Test, Bailar, Medell.)

II. GENERAL CHEMISTRY. *Lectures.*

The second semester proceeds with the metals, which follow in the order of their periodicity, in accordance with the periodic law. Elementary metallurgy is introduced as the commercially important metals are considered.

Prerequisites: Entrance requirements.

Text: Richter, *Inorganic Chemistry.*

Lectures four hours, recitation one hour, per week during the second semester of the Freshman year.

Required of all students.

(Fleck, Test, Bailar, Medell.)

III. QUALITATIVE ANALYSIS. *Lectures.*

The course treats of the theory of qualitative analysis and of special methods of identification. The law of Mass Action and the Dissociation Theory are drawn upon for the former, and standard works and current literature supply the latter.

Prerequisites: Entrance requirements.
First half of the first semester of Course I.

Texts: Prescott and Johnson, *Qualitative Analysis.*
School of Mines, *Qualitative Notes.*

Two hours lectures per week from Thanksgiving till the end of the first semester of the Freshman year.

Required of all students.

(Fleck, Test, Bailar, Medell.)

IV. QUALITATIVE ANALYSIS. *Lectures.*

The course proceeds with the study of the metals, their detection and separation by special methods, and dwells particularly upon correct interpretation of the reactions involved and precautions necessary to obtain correct results. Details concerning the treatment of compounds, including minerals and mixtures, are entered into.

Prerequisites: Course III.

Text: Prescott and Johnson, *Qualitative Analysis.*
School of Mines, *Qualitative Notes.*

Two hours per week during the second semester of the Freshman year.

Required of all students.

(Fleck, Test, Bailar, Medell.)

V. QUALITATIVE ANALYSIS. *Laboratory.*

The practice of manipulation and the study of the bases, their detection and separation, is begun.

Prerequisites: Entrance requirements.
First half of the first semester of Course I.

Texts: Prescott and Johnson, *Qualitative Analysis.*
School of Mines, *Qualitative Notes.*

Six hours per week from Thanksgiving till the end of the first semester of the Freshman year.

Required of all students.

(Fleck, Test, Bailar, Medell, Rockwood, Mertes.)

VI. QUALITATIVE ANALYSIS. *Laboratory.*

The practice of manipulation and study of the bases, their detection and separation are continued. The acids are then taken up and treated after the manner of the preceding. More complex substances are given for analysis. The decomposition, solution, and examination of refractory substances follow.

Prerequisite: Course V.

Texts: Prescott and Johnson. *Qualitative Analysis.*
School of Mines. *Qualitative Notes.*

Twelve hours per week during the second semester of the Freshman year.

Required of all students.

(Fleck, Test, Bailar, Medell, Rockwood, Mertes.)

VII. INDUSTRIAL CHEMISTRY. *Lectures.*

A broader acquaintance with industrial methods of chemistry, especially in the inorganic field, is an essential in the education of the engineer. The course is intended to supply this by illustrated lectures on chemistry applied to the arts and the apparatus used therein. Among the subjects considered are: explosives, and the raw materials used, including sulphur, charcoal, potassium nitrate, nitric acid, sulphuric acid, glycerine, and ammonia.

Prerequisites: Course I. to VI., inclusive.

Two hours per week during the first semester of the Sophomore year.

Required of all students.

(Bailar.)

VIII. INDUSTRIAL CHEMISTRY. *Lectures.*

The second semester continues with the following subjects: cements, fuels, clays, refractory materials, and boiler compounds.

Prerequisites: Courses I. to VI., inclusive.

Two hours per week during the second semester of the Sophomore year.

Required of all students.

(Bailar.)

IX. QUANTITATIVE ANALYSIS. *Lectures.*
(*GRAVIMETRIC.*)

The work of the first semester begins with a consideration of the theories of solution, electrolytic dissociation, and mass action as applied to analytical chemistry. The determination and separation of the elements and important radicals are considered in detail. The aim of the course is to study the general principles and methods of separation as used in quantitative analysis.

Prerequisites: Courses I. to VI., inclusive.

One hour per week during the first semester of the Sophomore year.

Required of all students.

(Test.)

X. QUANTITATIVE ANALYSIS. *Lectures.*

This is a continuation of Course IX.

Prerequisite: Course IX.

One hour per week during the second semester of the Sophomore year.

Required of all students.

(Test.)

XI. QUANTITATIVE ANALYSIS. *Laboratory.*

(*GRAVIMETRIC.*)

The work begins with the analysis of simple salts. By this means the practice of manipulation and the observance of necessary precautions are learned. Gradually the analyses of substances of more complex nature are introduced.

Prerequisites: Courses I. to VI., inclusive.

Text: Cairns, *Quantitative Analysis.*

Six hours per week during the first semester of the Sophomore year.

Required of all students.

(Fleek, Test, Bailar, Medell, Rockwood, Mertes.)

XII. QUANTITATIVE ANALYSIS. *Laboratory.*

This is a continuation of Course XI.

Prerequisite: Course XI.

Six hours per week during the second semester of the Sophomore year.

Required of all students.

(Fleek, Test, Bailar, Medell, Rockwood, Mertes.)

XIII. QUANTITATIVE ANALYSIS. *Lectures.*

(*VOLUMETRIC.*)

Credit one hour.

This course consists of a study of volumetric methods of analysis. First, the theory of indicators and methods of acidimetry and alkalimetry are taken up. Later, the methods of determination of the more important substances are studied. Special attention is given to the principles of the methods used in smelter practice

Prerequisites: Courses X. and XII.

One hour per week during the first semester of the Junior year.

Required in Groups I., III., and IV.

(Test.)

XIV. QUANTITATIVE ANALYSIS. *Laboratory.*
(VOLUMETRIC.)

Credit two hours.

This course covers the use of standard solutions and a study of the reactions involved. In due time the methods commonly used in metallurgical industries are introduced. A knowledge of the preparation of standard solutions and their use is acquired by a course in acidimetry and alkalimetry. The preparation of standard solutions and their use in the wet assays of ores and products containing iron, manganese, lead, zinc, copper, and other metals are practiced.

Prerequisites: Courses X. and XII.

Six hours per week during the first semester of the Junior year.

Required in Groups I., III., and IV.

(Fleck, Test, Bailar, Medell, Rockwood, Mertes.)

XV. QUANTITATIVE ANALYSIS. *Lectures.*

Credit one hour.

The previous studies in quantitative analysis principles are applied to the study of complex mineralogical products and those used in petographical differentiation.

Prerequisites: Courses XIII. and XIV.

One hour per week during the second semester of the Junior year.

Required in Group IV.

(Test.)

XVI. QUANTITATIVE ANALYSIS. *Laboratory.*

Credit two hours.

The work involves accurate study of the determinations in complex mineral and rock analysis.

Prerequisites: Courses XIII. and XIV.

Six hours per week during the second semester of the Junior year.

Required in Group IV.

(Test, Bailar.)

XVII. METALLURGICAL CHEMISTRY. *Lectures.*

Credit one hour.

The course undertakes a continuation of the principles involved in metallurgical laboratory practice.

Prerequisites: Courses XIII. and XIV.

One hour per week during the second semester of the Junior year.

Required in Group III.

(Fleck.)

XVIII. METALLURGICAL CHEMISTRY. *Laboratory.*

Credit two hours.

This is a continuation of Course XIV.

Prerequisites: Courses XIII. and XIV.

Six hours per week during the second semester of the Junior year.

Required in Group III.

(Fleck, Rockwood, Mertes.)

XIX. METALLURGICAL CHEMISTRY. *Lectures.*

Credit one hour.

A study of the principles involved in the laboratory practice of the metallurgy of the less common and rare metals.

Prerequisites: Courses VII., VIII., XVII., and XVIII.

One hour per week during the first semester of the Senior year.

Required in Group III.

(Fleck.)

XX. METALLURGICAL CHEMISTRY. *Laboratory.*

Credit two hours.

Practice in laboratory work connected with the metallurgy of the less common and rare metals.

Prerequisites: Courses VII., VIII., XVII., and XVIII.

Six hours per week during the first semester of the Senior year.

Required in Group III.

(Fleck, Rockwood, Mertes.)

XXI. COAL AND GAS ANALYSIS. *Laboratory.*

Credit one hour.

Prerequisites: Completed work of the Freshman and Sophomore years.

Three hours per week during the second semester of the Senior year.

Required in Group II.

(Bailar, Medell.)

XXII. GEOLOGICAL CHEMISTRY. *Lectures.*

Credit one hour.

A study of the principles involved in the methods of mineral and rock analysis. Exact water and gas analysis is included.

Prerequisites: Courses I. to XVI., inclusive.

One hour per week during the second semester of the Senior year.

Required in Group IV.

(Test.)

XXIII. GEOLOGICAL CHEMISTRY. *Laboratory.*

Two hours credit.

Practice in advanced mineral, rock, water, and gas analysis.

Prerequisites: Courses I. to XVI., inclusive.

Six hours per week during the second semester of the Senior year.

Required in Group IV.

(Test, Rockwood.)

XXIV. ADVANCED INDUSTRIAL CHEMISTRY. (Elective.) *Lectures.*

Credit one hour.

The object of this course is to give the student a knowledge of the principles underlying the manufacture and use of clay products and cement.

Prerequisites: Chemistry I. to XIV., inclusive.

One hour per week during the second semester.

(Bailar.)

XXV. ADVANCED INDUSTRIAL CHEMISTRY. (Elective.) *Laboratory.*

Credit two hours.

In this course the student is given work in the preparation of cement mixtures, the blending of clays, the correction of impure clays, and, in general, the preparation of clays for all purposes.

Prerequisites: Chemistry I. to XIV., inclusive.

Six hours per week during the second semester.

(Bailar.)

XXVI. RARE METALS. (Postgraduate.) *Lectures.*

Credit two hours.

The course undertakes the study of the raw materials, occurrence, localities of occurrence, geology and mineralogy, metallurgy, finished products, uses, and outputs of the rare metals.

Two hours per week during the second semester.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Fleck.)

XXVII. RARE METALS. (Postgraduate.) *Laboratory.*

Credit two hours.

Practice in the qualitative and quantitative analysis of rare metals and raw and finished products.

Six hours per week during the second semester.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Fleck.)

XXVIII. PHYSICAL CHEMISTRY. (Postgraduate.) *Laboratory.*

Credit two hours.

A course of laboratory practice in elementary physico-chemical measurements.

Six hours per week during the first semester.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Test.)

XXIX. ELECTROCHEMICAL ANALYSIS. (Postgraduate.) *Laboratory.*

Credit two hours.

The aim of this course is to give the student a practical knowledge of the electrochemical methods of analysis and the more common chemical reactions which take place under the influence of the electric current. That this object may be obtained, the course includes the estimation, by electrochemical means, of about fifteen of the more common metals and afterwards a separation of these metals. The principles learned are then applied to the analysis of minerals and smelting products. Later experiments are taken up illustrating the principles of oxidation and reduction, and a number of substances, the formation of which depends upon these principles, are prepared.

Six hours laboratory per week during the second semester.

This course in intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Test.)

PHYSICS.

Professor Louallen Frederick Miller.
Fellow Siegfried Fischer.

In arranging the courses of this department the aim has been to present thoroughly those physical principles and theories which are fundamental to all engineering subjects. It is also intended to prove the validity of the various physical laws, and to show that they are bound together by exact mathematical relations.

Many experiments accompany the lectures in order to demonstrate the practical relation of physics to engineering. Numerous problems are assigned in class which give each student experience in making practical applications of these laws and principles to elementary engineering problems. In the laboratory each student is required to verify quantitatively the laws and principles developed in the lectures.

I. GENERAL PHYSICS.

This course consists of lectures, illustrated by experiment, and recitations with assigned problems. The subjects treated are as follows: mechanics, including the elements of kinematics, dynamics and hydrostatics; the properties of matter; heat, including thermometry and expansion, calorimetry, change of state, conduction, radiation, and the elements of thermodynamics; sound, including wave motion in general, production and propagation of sound waves, pitch, reflection, refraction, interference, and resonance.

Prerequisites: Mathematics, I. to IV., inclusive.

Text: Duff, *Text-book of Physics.*

This course must be preceded by or taken in conjunction with Mathematics V.

Three lectures and two recitations per week during the first semester of the Sophomore year.

Required of all students.

(Miller.)

II. PHYSICAL LABORATORY.

This course is arranged to accompany Course I. Its aim is to teach the student the necessity of careful work as well as to acquire skill in physical measurements so that the important physical laws can be quantitatively verified.

Prerequisites: Mathematics, I. to IV., inclusive.
Physics I. must be taken in conjunction with this course.

Text: Reed and Guthe, *A Manual of Physical Experiments.*

Four hours per week during the first semester of the Sophomore year.

Required of all students.

(Miller, Fischer.)

III. GENERAL PHYSICS.

This course is a continuation of Course I. The subjects treated are as follows: light, including propagation, reflection, refraction, dispersion, interference, emission, absorption and polarization; electricity and magnetism, including electro-statics, electro-kinematics, thermo-electricity, magnetic induction, electro-magnetism, electrolysis, the electro-magnetic theory, and electric oscillations; conduction of electricity through gases and radioactivity.

Prerequisite: Course I.

Text: Duff, *Text-Book of Physics.*

Three lectures and two recitations per week during the second semester of the Sophomore year.

Required of all students.

(Miller.)

IV. PHYSICAL LABORATORY.

This course is a continuation of Course II.

Prerequisite: Course II.

Physics III. must be taken in conjunction with this course.

Text: Reed and Guthe, *A Manual of Physical Experiments.*

Four hours per week throughout the second semester of the Sophomore year.

Required of all students.

(Miller, Fischer.)

V. RADIOACTIVITY AND SPECTROSCOPY. (Postgraduate.)

Credit two hours.

In radioactivity, a study is made of radioactive substances and the theory of the phenomena. Experiments are given in the measurement of radioactivity and its detection in ores.

In spectroscopy, a study is made of the theory and use of the spectroscope, after which the measurement and determination of the spectra of the various metals is made, applying the spectroscope to the detection of rare metals in ores.

Six hours laboratory per week during the second semester.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Miller.)

MATHEMATICS.

PROFESSOR CHARLES ROLAND BURGER.
ASSISTANT PROFESSOR GEORGE EULAS FOSTER SHERWOOD.
INSTRUCTOR HARRY MUNSON SHOWMAN.

The courses in this department have been arranged to meet the extensive needs of students in the various branches of engineering. The subjects are treated so as to give the student both logical training and power of application. The principles which are of greatest value in engineering work are particularly emphasized. The courses offered serve as a sufficient prerequisite for the work in mathematical physics, physical chemistry, engineering and applied mechanics; and they mark the minimum of mathematical attainments that an engineer ought to possess. A special feature of the work is the early introduction of the calculus, the principles of which are introduced with those of analytic geometry and developed as needed, thus disregarding, to a certain extent, the traditional barrier that has existed between these subjects. By this means, the principles of the calculus are allowed to develop slowly, their sphere of usefulness is widened, the student gains a better grasp of mathematics as a whole, and is able, early in his course, to make direct application of his knowledge of mathematics to practical problems.

1. COLLEGE ALGEBRA.

This course begins with a rapid review of the fundamental operations as far as quadratics. Graphical work is early introduced in the belief that the illumination which it affords greatly enlivens the entire presentation of the subject and brings algebra into closer relationship with the other mathematical courses. Quadratics are given special emphasis. The progressions, inequalities, mathematical induction, proportion, variation, theory of limits, series, the binomial theorem, logarithms, exponentials, complex numbers, permutations, combinations, the theory of probability, and determinants are all amply treated. Those propositions of the theory of equations leading up to the various methods of approximating the roots of numerical equations are especially emphasized.

Prerequisites: Entrance requirements.

Text: Rietz and Crathorne, *College Algebra.*

Five hours per week during the first semester of the Freshman year.

Required of all students.

(Burger, Sherwood, Showman.)

II. TRIGONOMETRY.

The general formulas of plane and spherical trigonometry are developed. Inverse functions, identities, and trigonometric equations are carefully considered. Much practice is given in the use of tables and the applications of trigonometry to mensuration in general. The astronomical triangle and such problems relating thereto as occur in surveying are dwelt upon particularly and graphical representation is given its needed emphasis.

Prerequisites: Entrance requirements.

Texts: Crawley, *Elements of Trigonometry.*
Hodgman, *Surveyor's Tables.*

Three hours per week during the first semester of the Freshman year.

Required of all students.

(Burger, Sherwood, Showman.)

III. ANALYTIC GEOMETRY.

This course begins with the geometry of the point, straight line, and circle. The conic sections are studied from the equation derived from the general definition. The general equation of the second degree, with the term in *xy* wanting, is then taken up and from this the special forms relating to the ellipse, hyperbola, and parabola are deduced A thorough discussion of the most general equation follows. The methods and notation of the calculus are introduced early and are employed in the study of tangents and normals. The parametric equations of the conics and cycloids are developed and many applications to locus problems are introduced and discussed. The student is made familiar with the polar equations of the conics, spirals, ovals, and other plane curves. Emphasis is given to the graphical representation of the trigonometric, logarithmic, exponential, and other transcendental functions.

The analytic geometry of space is deferred until the second year when it is needed in the development of the calculus.

Prerequisites: Courses I. and II.

Text: Woods and Bailey, *A Course in Mathematics, Vol. I.*

Five hours per week during the second semester of the Freshman year.

Required of all students.

(Burger, Sherwood, Showman.)

IV. CALCULUS.

This course introduces the student to the elements of the calculus. The language, the symbols, and the first processes of the infinitesimal analysis are explained and many illustrations in geometry, physics, engineering, and applied mechanics are introduced. The fundamental principles of continuity, limiting values, and the theory of infinitesimals are established. The differentiation of all the fundamental forms and the application of the differential calculus to problems involving maxima and minima, rates, and to the theorems of analytic geometry comprise a large part of the course. Integration is introduced as the inverse operation of differentiation and is applied to numerous problems involving areas, velocities, and geometry.

Prerequisites: Courses I. and II.

Text: Woods and Bailey, *A Course in Mathematics, Vol. I.*

Three hours per week during the second semester of the Freshman year.

Required of all students.

(Burger, Sherwood, Showman.)

V. CALCULUS.

This course is a continuation of Course IV., in which students are made familiar with the elementary processes and applications of the differential calculus. A special feature of this course consists in carrying on the differential and integral calculus together. This method of instruction enables the student to grasp the more difficult notions of the subject in their inherent relations, and at the same time to apply this knowledge, early in the course, to the solution of engineering problems. The conception of the definite integral and its many applications are early introduced. The aim is to make clear the *rationale* of each process, and to arouse an early interest in the usefulness of the subject. The theory of single and multiple integration is applied to the principal methods of rectification and quadrature, and to the calculation of surfaces and volumes of solids of revolution.

Prerequisites: Courses I. to IV., inclusive.

Text: Woods and Bailey, *A Course in Mathematics, Vol. II.*

Five hours per week during the first semester of the Sophomore year.

Required of all students.

(Burger, Sherwood.)

VI. CALCULUS.

This course is a continuation of Course V. The elements of solid analytic geometry are introduced to assist in the proper development of the calculus of functions of two or more variables. Simple differential equations are introduced in close connection with integration. Multiple integration in rectangular, polar, and cylindrical co-ordinates is taken up and many applications are made to problems in areas, volumes, moments of inertia, centers of gravity, and pressure. Solids of revolution, cylinders, space curves, ruled and quadric surfaces are all given their needed emphasis as applications of the calculus. The last part of this course is pre-eminently a problem course. The aim is to review, in a practical way, the mathematics of the last two years and thereby encourage the student to look upon his mathematics as an instrument of power and usefulness rather than one of mental development and culture.

Prerequisites: Courses I. to V., inclusive.

Text: Woods and Bailey, *A Course in Mathematics, Vol. II.*

Five hours per week during the second semester of the Sophomore year.

Required of all students.

(Burger, Sherwood.)

VII. PRACTICAL ASTRONOMY. (Postgraduate.)

Credit two hours.

This course covers the following subjects: a study of the heavenly bodies; their mutual relations, their motions, forms, dimensions, and physical constitution; the relation of the earth to the heavens: the theory of the determination of time, latitude, longitude, and azimuth; attraction of the moon, tides; mass and density of the earth; problems of gravitation: astronomical instruments and their mathematical theory.

Lectures two hours per week during the first semester.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Burger.)

VIII. PRECISE SURVEYING AND GEODESY. (Postgraduate.)

Credit two hours.

This course covers the following subjects: an introduction to the methods of least squares; precise plane triangulation; base lines, standard tapes, corrections for temperature, sag, and pull; precise leveling; spherical and spheroidal geodesy; plumb line deflections; convergence of meridians; running parallel arcs; geodetic co-ordinates and map projections; reconnaissance; adjustments of triangles and quadrilaterals; the construction and use of tables.

Lectures two hours per week during the second semester.

This course is intended primarily for postgraduates, but may be taken by undergraduates with the consent of the instructor.

(Burger.)

ENGLISH.

PRESIDENT VICTOR CLIFTON ALDERSON.

I. ENGLISH. *Elective.*

Credit one hour.

The purpose of this course is to train the members of the Senior class to use clear, accurate, and simple English. Weekly themes are required which are carefully corrected and returned.

This course is intended only for the regular members of the Senior class.

One hour per week during the first semester of the Senior year.

(Alderson.)

II. ENGLISH. *Elective.*

Credit one hour.

This is a continuation of Course I.

This course is intended only for the regular members of the Senior class.

One hour per week during the second semester of the Senior year.

(Alderson.)

MINING LAW.

MR. JOSEPH S. JAFFA.

1. MINING LAW. *Elective.*

Credit one hour.

Beginning with a historical review of the growth of our present laws relating to mining, the course covers every feature of general interest to the practicing mining engineer.

This course is open only to Seniors.

One hour per week during the first semester of the Senior year.

(Jaffa.)

INSPECTION TRIPS.

The same importance is attached to the inspection trips as to class room and laboratory work. Grades are given on reports submitted and satisfactory results are required for graduation.

SENIOR TRIP.

At the conclusion of the Senior year an extended trip, lasting about a month, is made to important centers in Colorado, Utah, and Montana for advanced work in geology, metallurgy, mining, and engineering. Detailed work is assigned to each student. The results of his observations and investigations are carefully written and are criticised by his instructors. Six professors accompany the class and maintain the same high standard of study that is required at Golden. Private sleepers, day coach, and baggage car are chartered for the trip. Everywhere the greatest courtesies are extended. Not only are the plants thrown open for inspection, but members of the staff are detailed as guides. Many students secure good positions during the trip and form acquaintances that are apt to be of value to them later.

ITINERARY.

COLORADO.

PORTLAND.

Metallurgy.

Colorado Portland Cement Company: crushing and fine grinding of raw material and clinker.

CANON CITY.

Metallurgy.

Empire Zinc Company: wet and magnetic separation of zinc ores and magnetic treatment of Wilfley table middlings; experimental plant with magnetizing roaster, magnetic separators, dry and electrostatic separators, and Elmore installation.

United States Smeltery: pigment smelting of complex zinc-lead ores, and the working of the product into a marketable form.

Geology.

A study of the mesozoic sedimentary formations that are upturned in fine hog-backs in a great semicircle around the Canon City basin.

LEADVILLE.

Metallurgy.

Arkansas Valley Plant of the A. S. and R. Company: lead smelting; Ropp, Brown-Horseshoe, Godfrey, and H. and H. roasting; briquetting, and blast furnace treatment of silver-lead ores.

Adams Mill: wet concentration of lead ores.

Yak Mill: magnetic concentration with International separators and Cleveland-Knowles separators, after a magnetizing roast.

Mining.

The students are taken into the Yak Tunnel, through the several mines connected therewith, and are finally hoisted to the surface of Breece Hill through the shaft of the Little Jonny mine. The Moyer, Tucson, and other mines are also visited. Excellent opportunity is afforded for studying the two distinctive kinds of ore bodies for which this district is noted, and to learn, by observation, how these dissimilar ore bodies are attacked and their contents successfully extracted. Interest attaches to the unusual complexity of the ores, which contain gold, silver, and most of the base metal sulphides, oxides, and carbonates.

Engineering.

Arkansas Valley Plant, A. S. and R. Company; steam power plant; capacity 1,500 H. P.; condensing Corliss engines belted to Connersville blowers; return tubular boilers equipped with underfeed stokers.

Central Colorado Power Company: steam power plant; Curtis turbines, direct connected to 3-phase, 6,600 volt, 60 cycle alternators; current stepped up to 50,000 volts for long distance transmission over steel tower line; small and moderate sized units; Alberger surface condensers with independent dry vacuum pump and centrifugal circulating pump; 400 H. P. B. and W. boilers, hand fired.

Yak Tunnel: Silver Cord property; two-drum electric hoist; motor driven compressors; compressed air and electric driven pumps; continuous current haulage.

Geology.

The paleozoic series and fault systems are studied underground and the sharply defined moraines, and other glacial phenomena, on the surface.

SHOSHONE.

Engineering.

Central Colorado Power Company's Hydro-electric plant. Water from the Grand river is conducted through a tunnel cut inside of the mountain for approximately two and one-quarter miles, delivered through penstocks to central dischage turbines under a head of 165 feet; ultimate capacity of plant approximately 25,000 H. P.; ultimate transmission voltage 100,000.

SHOSHONE AND GLENWOOD.

Geology.

Archæan gneisses and schists, and uncomformable above these the paleozoic rocks exposed in the canyon of the Grand river; typical canon erosion and travertine deposits. At Glenwood the mesozoic rocks.

UTAH.

BINGHAM.

Mining.

This district permits the study of three distinct systems of mining, namely, the overhead stoping, the caving, and the open pit. The extensive properties of the Utah Consolidated Mining Company and the Utah Copper Mining Company are open to the unrestricted inspection of the class. Further interest in this district comes from the opportunity to study aerial tram systems, difficult railroad engineering, and the operations of single companies under different systems.

Geology.

The carboniferous quartzite and limestone, with intruded igneous masses that have marmorized the limestone at contact; the relationship of the ore bodies to these contact phenomena.

BINGHAM JUNCTION.

Metallurgy.

United States Smelting Company: special roasting devices for lead ores, with neutralization and bag-housing of fumes.

GARFIELD.

Metallurgy.

Boston Consolidated Mining Company Mill: stamp milling of Bingham copper ores with Wilfley table and vanner concentration.

Utah Copper Company: roll crushing of Bingham ores with jigging, tabling, and vanning methods of concentration.

Engineering.

Utah Copper Company: steam power plant: capacity 10,000 boiler H. P.; 500 H. P. Heine boilers equipped with underfeed stokers; forced draft; concrete stacks; large cross compound Allis and Nordberg engines direct connected to A. C. generators; Wheeler surface condensers with independently driven Edwards air pumps.

American Smelting and Refining Company; steam power plant; large horizontal blowing engines; single stage air compressors driven by cross compound Corliss engines; Worthington surface condensers with Blake air and circulating pump; 500 H. P. Stirling boilers equipped with plain grates.

SALT LAKE CITY.

Metallurgy.

General Engineering Company; special devices for screening, classifying, and concentration of ores.

Geology.

Excursion into the Wasatch range, showing the great synclinal fold and the Wasatch fault; very recent faults and glacial features; Lake Bonneville terrace formations.

MONTANA.

BUTTE.

Metallurgy.

The Colusa-Parrot Smelting Company: crushing, wet concentration, roasting, and smelting of copper ores; Hancock and Woodbury jigs and special devices of local origin.

The Precipitation plants: recovery of dissolved copper from mine waters; leaching and recovery of soluble values from dumps.

Mining.

The mines of this district exhibit modern practices of lode mining in high grade copper ore. Among the noteworthy mining features studied are: deep mining with the involved difficulties of drainage, ventilation, and timbering; steel surface structures; automatic loading and dumping of ore; rapid hoisting; mechanical framing of timbers; handling of large volumes of acid water; square set stoping; the driving of working levels in country rock; the naturally high temperatures of the working places; and the systematic recording of every operation. Mine and geological underground surveying are exemplified in the practices of the Amalgamated Copper Company.

Geology.

Secondary enrichment of original sulphide ores; the relationship of these ore bodies to the remarkable fault systems of Butte; the study of granite, aplite, porphyry, and rhyolite rocks.

Engineering.

Amalgamated Copper Company: mine plant at the New Leonard; 3,500 H. P. Nordberg hoist; 150 foot steel head frame; two stage Nordberg air compressors rope driven by induction motors; locomotive type of boilers.

Amalgamated Copper Company: mine plants at the Diamond and Bell mines; very large air compressing plant; two stage compressors equipped for either steam or motor drive; 3,000 H. P. Allis hoisting engine; marine type of boilers; high steel head frame with automatic dumping attachments.

Missouri River Power Company: steam power plant: Westinghouse-Parsons turbines, connected to A. C. generators; surface condensers with independently driven air and circulating pumps; B. and W. boilers equipped with Roney stokers; high tension current station used as relay for the company's hydro-electric plants and operated in parallel with them.

ANACONDA.

Metallurgy.

New Reduction Works: track system for the delivery of ores and shipment of products; compressed air traction for yard haulage; concentrating mill of eight one-thousand ton units; bin systems; briquetting plant; largest furnaces in the world; reverberatory furnaces; converter plant; refining furnaces and casting department; arsenic plant, and flue systems. So much is to be seen here that considerably more time is spent in this plant than at any other point, and, owing to the courtesy of the management, much valuable instruction is possible.

The Anaconda Copper Mining Company: brick department; the manufacture of clay and silica brick of the highest degree of refractoriness and of all shapes.

Engineering.

New Reduction Works; general power plants; large triple expansion condensing Corliss engines belted to line shaft; two and four stage air compressors driven by cross compound Corliss engines; rotary blowers of the Connersville and Root types, direct connected to Corliss engines; rotary blowers, rope driven from induction motors; Stirling boilers equipped with plain grates; rotary converters and transformers for the high tension current brought in from the hydro-electric plants.

ELECTRICAL AND MECHANICAL POWER PLANT TRIPS.

In connection with the Junior mining trip to Breckenridge, Colorado, a study is made of the application of electric power to dredging, milling, and mining. Near the end of the Junior year the class visits the plants and sub-stations of the Denver City Tramway Company and of the Denver Gas and Electric Company. Here they see in operation nearly all the electrical machinery and apparatus studied during the year. The Seniors make a combined steam and electric plant trip to the station of the Northern Colorado Power Company at Lafayette, Colorado.

INDUSTRIAL CHEMISTRY TRIPS.

In connection with the course in Industrial Chemistry, inspection trips are made to the plant of the Denver Gas and Electric Company for a general study of artificial fuels and the treatment of by-products, also to the plants of the Western Chemical Manufacturing Company, the Denver Sewer Pipe Company, the Golden Pressed and Fire Brick Company, and to the brick yards near Golden.

METALLURGICAL TRIPS.

The study of various metallurgical processes and plants may be prosecuted with great benefit in Colorado. Beginning with the Junior year and continuing throughout the Senior year, inspection trips are taken for the purpose of supplementing the laboratory work and for illustrating the lecture courses. Printed outlines of reports, carrying out all of the important features peculiar to the plant and to the practice, are given to the students. A written report on each trip is turned in for correction and criticism.

During the Junior year the following plants are visited:

The Pueblo plant of the American Smelting and Refining Company and the plant of the North American Smelter and Mines Company at Golden, for a study of furnaces of various types and ore sampling.

The Minnequa plant of the Colorado Fuel and Iron Company at Pueblo, for a study of the manufacture of iron and steel and the working up of the product into commercial forms.

The Globe plant of the American Smelting and Refining Company, for a study of the metallurgy of lead.

The zinc plants of the American Smelting and Refining Company at Pueblo, and of the United States Smelting Company at Canon City, for a study of the metallurgy of zinc and the manufacture of pigment.

During the Senior year the following plants are visited:

The Jackson, Newton, Hudson, and other mills in Idaho Springs, for the study of ore dressing.

The various stamp mills of Black Hawk and Central City, for the study of amalgamation.

The Colorado Zinc Company and the Blake-Morscher works in Denver, for magnetic and electro-static separation.

The cyanide mills of Colorado City and Cripple Creek for the cyanide process.

The Portland and Standard mills at Colorado City, for the chlorination process.

MINING TRIPS.

During the Junior and Senior years, the students are taken to well known Colorado mining districts for the inspection of actual mining operations. These trips are arranged in such order as to introduce different interesting features and, at the same time, to emphasize definite portions of the classroom instruction. Attention is paid to surface plants, underground equipment, mining systems, and to all the regular operations, both above and below ground. Lectures precede these trips to explain their objects, the particular properties to be visited, and the operations to be witnessed. Printed outlines are furnished and each student is required to submit a report, illustrated by his own sketches.

The Juniors take their first trip in the autumn to the Breckenridge district to study the various kinds of placer mining. To be eligible to take this trip, the student must be enrolled in, or have completed, Mining, Course V.

In the second semester of the Junior year, this class goes to the Cripple Creek district and visits several of the famous mines. This trip must be taken in conjunction with, or subsequent to, Mining, Course VI.

The Seniors, during the first semester, are required to visit one of Colorado's coal mining districts. The only prerequisite for taking this trip is the successful completion of such Junior Mining lecture courses as are prescribed for the group in which the student is enrolled.

In the second semester, the Seniors of Group II. visit another coal mine for the purpose of taking data in more detail than is possible when the first coal mining trip is made. Particular attention is given to all kinds of underground machinery and mining methods. The surface plant is studied in such a way as to apply the instruction given in the class room, drafting room, and laboratory to actual working conditions. Eligibility to take this trip is based upon enrolment in Mining, Course XIII.

Advanced standing and postgraduate students, who have not taken the trips, will be required to take them at such times as they occur, but only when the prerequisite lecture courses have been taken in regular classes.

BUILDINGS.

SIMON GUGGENHEIM HALL—Administration Building.

This building, the gift of Senator Simon Guggenheim, of Denver, was erected and furnished at a cost of $80,000. The corner-stone was laid by the A. F. and A. M. of Colorado, October 3, 1905. It is one hundred sixty-four feet long by fifty-seven feet wide and is surmounted by an ornate tower. The first floor is devoted entirely to the Department of Geology and Mineralogy, and includes lecture room, laboratory, office, two work rooms and public museum; the second floor contains the library, the office of the President, Secretary, and Registrar, the Faculty Room and the Trustees' Room; the third floor contains the Assembly Hall, two lecture rooms for Mathematics, an office, and the Tau Beta Pi room. The building was dedicated October 17, 1906.

HALL OF CHEMISTRY.

This is a continuous group of brick buildings, comprising the buildings of 1880, 1882, and 1890. The combined buildings of 1880 and 1882 contain the main chemical laboratories. In the building of 1890 are located the office and laboratory of the professor of Chemistry, the chemical lecture room, the Museum of Applied Chemistry, three recitation rooms, the laboratories for gas and water analysis, and the Freshman drawing room.

ASSAY BUILDING.

This building, a brick structure forty-six by ninety-two feet, was built in 1900 through funds contributed by the late W. S. Stratton, and enlarged in 1905 to allow for the installation of a new equipment of furnaces of the gasoline type. The design and equipment of this building are such as to make it probably the best of its kind in the country.

GYMNASIUM.

This building, costing $65,000, was completed in September, 1908. The first floor contains a room for boxing and wrestling, besides shower baths, locker room, and swimming pool finished in white marble and tiling.

The second floor contains the offices and the Integral Club room.

The third floor is the gymnasium room proper, fifty-five by one hundred five feet without posts. A gallery accommodates two hundred spectators.

HEATING, LIGHTING, AND POWER HOUSE.

The power plant recently erected at a cost of forty thousand dollars, was designed to furnish light, heat, and power to the entire school. It is a simple but artistic brick building, eighty-three by one hundred twenty-two feet, with concrete floors and tile roof. The building is divided lengthwise into an engine room thirty-four feet wide, and a boiler room forty-five feet wide. A conduit six feet wide and seven feet high surrounds the engine room below the floor and is used for steam and electric mains. A brick-lined steel stack one hundred twenty-five feet high carries all smoke to the upper air and away from the buildings.

HALL OF PHYSICS.

This building, constructed of red pressed brick, consists of two floors and a basement, and was completed in the fall of 1894. The upper floor contains two physical laboratories, one for electricity and magnetism, and the other for heat and sound, an instrument room and office. The physics lecture and apparatus room, the photometry room, the physical laboratory for mechanics and light, the balance and apparatus room as well as a private office and laboratory occupy the first floor. The basement contains the electrometallurgical laboratory, pyrometry and high temperature laboratory, electro plating room, a magnetic testing laboratory, a laboratory for the study of radioactivity and rare metals by spectroscopic methods, a Junior electrical laboratory, a storage battery room and switchboard with connections to all parts of the building.

STRATTON HALL.

The corner-stone of this building was laid by the A. F. and A. M. of Colorado, on November 20, 1902, and was completed in January, 1904. The basement wall and first story are of Lyons sandstone, in broken ashlar, topped by a story of gray Golden brick. The building is finished on the interior with red pressed brick. Little wood is used, except in the floors and staircases. The basement accommodates the metallurgical and ore dressing laboratories. The first floor contains two large lecture rooms, each with apparatus room and private office. The second floor, in one-half, accommodates the surveying and mechanics in one large lecture room, with apparatus room and private office, and in the other half a drafting room. The third floor is devoted entirely to a large drafting room for the Senior class. The structure was named in honor of the late W. S. Stratton, whose gift of twenty-five thousand dollars made the building possible.

THE EXPERIMENTAL ORE DRESSING AND METALLURGICAL BUILDING.

This building, 100 by 150 feet, erected in 1910, was made possible by an appropriation of $75,000 by the Legislature of Colorado.

It is situated on the bank of Clear Creek, a short distance from the Campus. It is intended to be not only a laboratory for the use of the students in Ore Dressing and Metallurgy, but a commercial testing plant for the benefit of the mining industry.

RESIDENCE OF THE PRESIDENT.

This is a brick building of two and one-half stories. It was built in 1888.

CARPENTER SHOP.

This is well equipped for the special demands which are continually arising in a technical school. The work varies from ordinary repair work to the careful construction of special apparatus needed in the various departments of the school.

MACHINE SHOP.

What has been said of the carpenter shop is equally true of the machine shop. It is imperative that the school have shops of its own, in order to keep its mechanical apparatus in proper working order, as well as to construct such apparatus as is necessary to carry on any new or original work. The machines of both shops are driven by direct connected motors.

LABORATORIES AND EQUIPMENT.

MINERALOGICAL AND GEOLOGICAL LABORATORY AND CABINET.

Under the name cabinet is embraced not only the distinctively display collections, which may perhaps be called the cabinet proper, but also the other collections that have been prepared mainly for the purpose of class instruction. These collections are necessarily changing rapidly from year to year, as new material is constantly being added. This new material is obtained partly by purchase, but mainly by direct collecting, by gifts, and by means of exchange with other institutions. The display collections are not classified systematically, but are arranged in different cases with a view to displaying certain groups of minerals, or minerals from certain localities.

SUMMARY OF COLLECTIONS.

Type Collection of Minerals	3,700
Working Collection of Minerals (about)	21,000
Display Collection of Minerals	1,305
Supplementary Collection of Minerals	950
Crystal Collection	1,800
Display Collection of Fossils	342
Miscellaneous Collection of Fossils	1,360
Type Collection of Rocks	1,800
Working Collection of Rocks	7,408
United States Geological Survey Educational Series of Rocks	156
Professor Patton's Collection of Rocks	1,700
Professor Patton's Collection of Minerals	970
Summary of specimens	42,491

EXCHANGES.

The college has prepared a printed list of exchange material, covering both minerals and rocks. The list will be sent to all who wish to arrange for exchanges. Correspondents should state what material they are prepared to offer in exchange. Letters should be addressed to Professor H. B. Patton, Golden, Colorado.

MINERALOGICAL LABORATORY.

Aside from the special advantages due to location, the Department of Geology is admirably equipped for practical teaching. The entire first floor of Guggenheim Hall is occupied by this department. The south end of the building is occupied by a commodious lecture room, with a seating capacity of over a hundred, and by a separate mineralogical laboratory with table space for between fifty and sixty students, also by two small recitation rooms. On the extreme north end of the building is the public museum, devoted to a display of fine minerals. Additional space is provided for working rooms, offices, packing, and storage rooms.

METALLURGICAL COLLECTIONS

The college has a fine collection of models from the works of Theodore Gersdorf, Freiberg, Saxony, which illustrate the best type of furnaces in this and other countries. Each model is made to scale and is complete in every detail. In addition to these models are the following illustrating the best modern practice:

Working model of a twenty-stamp mill, on a scale of one and one-half inches to the foot.

Working models of crushing rolls.

Working model of a Dodge crusher.

Model of modern blast furnace for lead-silver ores, with water jacket.

There are also a large number of smaller models, such as the completed set used in the famous Keyes and Arents lead-well suit.

METALLURGICAL LABORATORY.

This laboratory is equipped with apparatus for the study of the quantitative relations of the various agencies taking part in metallurgical changes.

The Junker, the Mahler Bomb, and the Parr calorimeters, the Wanner optical, the Le Chatelier, and Bristol electrical pyrometers, together with sets of the American Gas Furnace Company's gas furnaces, and Hoskin's gasolene furnaces are used for securing the desired temperature for experimentation. These furnaces also serve for the necessary assaying demanded in the metallurgical laboratory. Desks and apparatus are provided for small scale work in amalgamation, chlorination, and cyanidation; for larger scale work a battery of eight amalgamation pans, devised to be operated together or independently by power, several sets of cyanide tanks, including a Braun Laboratory Cyanide plant, and a chlorination barrel, are provided. There is also a Hendryx combined agitator and filter, and a Hendryx agitator for hydro-metallurgical treatment of copper ores, dry chlorination apparatus, and a Paterson agitator for cyaniding slime.

ORE DRESSING LABORATORY.

The equipment of the ore dressing laboratory, in Stratton Hall, at present consists of the following apparatus: Sturtevant roll jaw crusher, Colorado Iron Works rolls, Foerster crusher, Case crusher, Bosworth crusher, Vezin disc pulverizer, Braun's perfection crusher, Braun's disc pulverizer, Braun's Chipmunk crusher, Braun's sampling machine, Denver Engineering Works sample grinder, Wilfley table, Card concentrating table, accelerated pulsation jig, set of spitzkasten and all the necessary apparatus for systematic sampling of large and small parcels of ore, a Blake-Morscher electrostatic separator, a Richards Pulsator classifier, and a Richards Pulsator jig. For small scale work, Munroe's slime table, Vezin jig, Munroe classifiers, and other devices, are supplied.

ASSAY LABORATORY.

This laboratory is well equipped with parting, balance, and store rooms and office, and thirty-two coal-fired muffle furnaces. Each student has his own muffle, with his own coal bin, pulp balance, and desk, conveniently arranged with regard to his furnace; he has also access in the balance room to the best assay and pulp balances to be obtained on the market. The equipment of gasolene furnaces includes one crucible, four combination, and three muffle furnaces, one crude oil burner, one tempering furnace, and a bullion and tempering furnace, all of the F. W. Braun & Co. type; also three Case muffle furnaces, one improved Case high temperature muffle, and one Case crucible furnace, two Braun cupel machines, two Iler cupel machines and two bullion rolls, one of which is of the Braun type. In order to avoid dust, change of temperature, and direct sunlight, the balance room has no outside walls, and is lighted by means of skylights. The equipment here includes four special pulp balances, five silver, three gold balances, one Thompson multiple rider balance, and one Mine and Smelter Supply Company, Wilfrid Heusser No. 1,000 button balance, sensitive to 1-500 milligram. The variety of makes is as great as possible, so as to acquaint the student with the various mechanisms and adjustments in assay balances.

SURVEYING EQUIPMENT.

The equipment of the department of surveying is well adapted to the practical course given. Students are organized into parties for field work. Each party is assigned instruments, rods, flags, steel measuring tapes, marking pins, and such other essentials as may be necessary. Students are required to furnish note books, hatchet, and extra plumb-bobs. For transit work there are twenty-five light mountain transits, six of which are provided with solar attachments for determining the meridian and latitude, and eleven of them are provided with auxiliary telescopes for underground work. There are also three heavy transits, one of which is of English and one of German make. In addition to the transits there are two plane tables for taking topography. For leveling, seven wye levels and five dumpy levels of standard manufacture are used. The department is well supplied with leveling-rods of various makes and types, stadia rods, hand levels, clinometers, flagpoles, and other accessories. The instruments noted above are manufactured by such well-known firms as C. L. Berger and Sons, Buff and Buff, Heller and Brightly, Eugene Dietzgen and Co., Peter Herr and Co., W. and L. E. Gurley, Keufel and Esser, William Ainsworth and Sons, Weiss and Heitzler, Young and Sons, Negretti and Zambra (English), and Max Hildebrand (German). Additions are constantly being made to keep pace with the growth of the school and to replace worn-out instruments.

MUSEUM OF APPLIED CHEMISTRY.

The Museum of Applied Chemistry is located on the first floor of the Hall of Chemistry. The object in establishing this museum is to aid in a practical way the courses in applied chemistry and metallurgy. Mounted specimens of raw materials, main products, by-products, and waste products of the various branches of technical chemistry and metallurgy are a direct stimulus in the study of these branches. The specimens already collected for the museum represent, among other things, the various stages of the manufacture of brick, fire brick, tile, cement, electrolytic alkalis, natural alkalis, electric furnace products, carborundum, alundum, carbide, rare metals, and ferro alloys.

CHEMICAL LABORATORIES.

The Freshman, Sophomore and Junior laboratories accommodate two hundred ninety-five students, and are equipped with especially designed tile-topped oak desks, provided with low reagent shelves, gas, water, filter pumps, and large porcelain sinks. The balance rooms are equipped with Sartorius, Becker, and Spoerhase balances. Gas is supplied to the building from a 300-light Detroit gas machine, which is connected with buried supply tanks outside the buildings. Good ventilation is obtained by means of two Sturtevant fans.

Gas Analysis Laboratory.—Throughout the day the room affords an even temperature and is well lighted. Window space is reserved for a Lothar Meyer modification of the Bunsen eudiometer and a cathetometer. The laboratory also contains a complete Hemple and Elliott outfit, together with special apparatus for the collecting, storing, and handling of gases.

Water Analysis Laboratory.—This laboratory adjoins and communicates with the gas analysis laboratory, and contains a full equipment of ordinary and special apparatus for water analysis. It is situated apart from the general laboratories and is particularly free from contaminating fumes.

HYDRAULIC LABORATORY.

The hydraulic laboratory contains weirs and orifice tanks for the determination of coefficients of discharge, calibrated tanks for water measurement, a steel pressure tank for artificial heads, pumps for water supply, and gages for pressure. A hydraulic ram is used to illustrate this class of apparatus and for testing. A long sheet iron trough, with a car over it is used for calibrating current meters. Water wheels and centrifugal pumps are tested for efficiency under various conditions of head and load. A swinging tank is used to measure jet reactions. Friction losses in pipes and elbows are measured. Hook gages are used for the accurate determination of low heads. Streams and ditches in the vicinity of Golden are gaged by means of the current meter, by rod floats, by slope, and by Pitot Tube.

PHYSICAL LABORATORIES.

The physical laboratories are composed of three laboratories located in the Hall of Physics. The laboratory for mechanics and light is located on the first floor. Adjoining is a balance and instrument room and a dark room containing a complete Lummer-Brodhun photometer and an optical bench. On the second floor are the laboratories for electricity and magnetism, and for heat and sound. The equipment is particularly adapted to the instruction of students of engineering, and it is designed to teach the principles of elasticity and efficiency of machines, composition and resolution of forces, various forms of motion, density, velocity and pitch of sound, focal length of lenses, magnifying power, and the principles of the construction of telescopes. The heat laboratory is particularly well equipped for calorimetry, heat expansion determinations, and for the determining of the mechanical equivalent of heat. A complete line of galvanometers, standard resistances, condensers, ammeters, voltmeters, dynamometers, permeometers, standard cells and a Kelvin balance compose the electrical apparatus; in magnetism all the principles which underlie the construction of magnets for lifting purposes and the separation of ores, are demonstrated in the laboratory.

ELECTROMETALLURGICAL LABORATORY.

The electrometallurgical laboratory is located in the basement of the Hall of Physics. It consists of a main room, adjoining which are the storage battery room, a room for cleaning, polishing, and electroplating, and a room for pyrometry and high temperature work. The main laboratory covers a space of 25 by 45 feet and contains sixteen desks. All desks are equipped with voltmeters, ammeters, rheostats, and terminals leading to a central switchboard where connections may be made to a full set of storage cells, direct or alternating current, and two large wire rheostats. Besides platinum electrodes, stirring devices, rotating anodes and such chemical apparatus as is necessary for electro-chemistry, there is a complete equipment of electrical apparatus for studying the principles and conditions involved in electrolytic plants and electrical furnace work.

When a student has completed this course it is expected that he will be in a position to investigate and to understand all the conditions relating to an electrolytic plant, such as density of solutions, temperature effects, and the nature of different electrodes and electrolytes, also all the principles involved in the use and correction of pyrometers, the conversion of electrical energy into heat, and the efficiency of electrical furnaces. A few simple alloys are made and then such properties tested as their coefficient of elasticity, coefficient of heat expansion, resistance, temperature coefficient of resistance, and whatever magnetic properties they may possess. All the apparatus is arranged so that it may be available for research or investigation along any of these lines.

MECHANICS OF ENGINEERING LABORATORY.

The laboratory is provided with a motor-driven 100,000-pound Riehle testing machine arranged for experiments in tension, compression, shearing, and flexure of materials of construction. Extensometers for measuring elongations and compressions are employed. Numerous steel sections provide useful problems in determining centers of gravity and moments of inertia. Experiments to determine the strength of threaded bolts, riveted joints, welds, and nailed joints are included in the course. Tests of specific gravity and absorption of porous building materials such as brick and stone are also made.

CEMENT LABORATORY.

The apparatus in this laboratory consists of a twelve hundred pound Riehle testing machine for testing briquettes in tension. A nest of sand sieves gages the sand used in tests. Standard Ottawa sand is used for briquettes as well as the local river sand in order to compare the latter with standard tests. Scales and volumeters are provided for measuring quantities in bulk. The specific gravity of cement is determined by means of Le Chatelier apparatus. A nest of fineness sieves and a very sensitive set of scales equip the student for the fineness test. Setting is determined by means of the complete Vicat apparatus. Trowels, spatulas, large slate mixing boards, beakers, moulds, damp box, and immersing vats, provide apparatus for the making and setting of briquettes and for the soundness tests. Moulds are used for making cubes of concrete for compression tests.

ELECTRICAL LABORATORY.

This laboratory is equipped with standard voltmeters, ammeters and wattmeters, inductive and non-inductive resistances for artificial loads, a Thomson apparatus for induction experiments, a slip indicator for induction motors, an automatic speed recorder which can be used for finding the acceleration curves of motors, an Alden absorption dynamometer for motor testing, a contact apparatus for alternating current and voltage wave form, a split phase rotary field apparatus, a 10,000 volt oil switch in a glass receptacle so that its action may be observed, a horn break cutout, tank and transformers used in insulator tests. The generators available for laboratory work include a 100 K—V. A. 2300 volt, 60 cycle, 3 phase Westinghouse alternator, driven by a Westinghouse producer gas engine, a 75 K. W. 240 volt, 3 wire, D. C. Westinghouse generator, driven by a 112 H. P., 2300 volt, 3 phase, synchronous motor, a 75 K. W. Bullock twin unit continuous current generator set, driven by a 110 H. P. De Laval Turbine, a 30 K. W. 1100 volt, 125 cycle, single phase General Electric alternator, a 15 K. W. 130 volt compound, continuous current generator designed and built at the school, an 8 K. W. Crocker-Wheeler generator, a 6 K. W. 130 volt Westinghouse generator, a 2 K. W. 120 volt compound brush machine, a series arc light machine, and a small Edison shunt generator. The Bullock generators can be connected at the switchboard to supply the 120-240 volt 3 wire lighting and power circuits, or they can be put in parallel and thus supply over 600 amperes for electro thermic work. The motors include a 10 H. P. 220 volt, 60 cycle, 3 phase constant speed induction motor of General Electric make, a 5 H. P. 3 phase, two-speed induction motor, used for electric drilling, a 4 H. P. single phase Wagner motor, a 400-2000 R. P. M. variable speed experimental motor designed and built at the school, a 20 H. P. series motor, and a large number of 3 phase motors and shunt machines of standard makes in daily use about the shops and buildings. Two storage batteries of 54 cells each are in daily use and are available for study. In addition to the above generators and motors, a modern 5 panel D. C. switchboard and 7 panel A. C. and D. C. switchboard with the usual instruments, switches, and auxiliaries, afford excellent opportunity for the study of electric plant equipment.

MINING LABORATORY.

The laboratory work in mining is carried on principally at the tunnel belonging to the college. The equipment here consists of numerous drills which are taken apart, reassembled, and used by the student; forges, anvils and tools for blacksmithing; the air receiver, valves, gages, fuses and switches connected with the compressed air and electric power transmission from the power plant; two mining cars; materials for track laying; and all other supplies usually found at a tunnel house. Among the makes of rock drills used by each student are Rand, Ingersoll, Sergeant, Leyner, McKiernan, Wood, Hardsocg, Shaw, Waugh, and Temple-Ingersoll. All of the mountings, such as bars, tripods and arms, and a supply of drill steel, are also provided. In the laboratory at the school are two working size models of the Bleichert system of aerial trams; numerous models of mines; an explosive tester; a collection of rock cores taken by diamond drills; models of timbering methods; many maps of actual mines; instruments for measuring ventilation; thousands of lantern slides illustrating mining operations; samples of wire ropes and drill steels; collections of typical rocks and ores from famous districts and mines; lamps of the open and safety patterns; a dry placering machine, and many photographs of mines and operations.

RARE METALS LABORATORY.

This laboratory is equipped for research in the rare metals along two principal lines, radioactivity and spectroscopy. Under radioactivity come such elements as radium, uranium, thorium, actinium, and polonium. To investigate these, there is all the apparatus necessary for accurate quantitative observations with the electrometer, and also with a field type of electroscope which gives very good quantitative results, but is especially designed to investigate the radioactivity of mineral waters, gases, and ores found in the field bearing radioactive elements. For the investigation of other rare elements there is a small thirty-six inch, three prism spectograph and a large fourteen-foot Littrow type of spectrograph. The equipment contains all necessary accessories such as arcs, spark terminals, various types of vacuum tubes, vacuum pump, and a photographic outfit. In conducting research along either of these two lines the work necessarily branches into chemical and electrochemical lines. Therefore the laboratory is also provided with separate desks for each, containing a complete chemical and electrochemical equipment.

DRAWING ROOMS.

Freshman and Sophomore.—This occupies the top floor of the Hall of Chemistry. The floor area is about four thousand square feet. It is lighted by windows on the north, east and west, and by eight large skylights in the roof. A suitable office for the instructors is located in a central position, in which all drawings are filed and all records are kept. Each student is provided with a drawing table, a drawer, a drawing board, and a stool. The present equipment accommodates about one hundred fifty students. There are a great many models to aid the students in their work.

Junior and Senior.—The entire third floor of Stratton Hall is used for the Junior and Senior drawing. The room is 90 by 60 feet, lighted by windows and a large skylight. Each student is provided with a drawing table, a drawer, a drawing board, and a stool. Most of the drawing tables are independent and adjustable. The room has recently been equipped with especially constructed tables for the advanced work of the Seniors. The present equipment accommodates about one hundred sixty students. There is a blue print room fully equipped with an adjustable printing frame and all other necessary appliances. In one corner of the room is located the office of the instructors where all drawings and records are filed. There is for the use of the students a complete set of catalogues and a great many blue prints from outside concerns. These are kept up to date.

MECHANICAL ENGINEERING LABORATORY.

The heating, lighting, and power plant is well equipped for mechanical engineering laboratory practice. The boiler room contains the following principal equipment: one 200 H. P. and one 100 H. P. Babcock and Wilcox water tube boilers, each equipped with a chain grate; one 100 H. P. tubular boiler equipped with plain grate; Green Engineering Company fuel economizers; Babcock and Wilcox independently fired super-heater; Webster feed-water heater, boiler feed and vacuum pumps and injectors; a 125 by 5-foot self-supporting steel stack supplemented by a steam driven 42-inch Sirocco fan for induced draft; eight 25-ton steel bunkers for coal storage; and a 125 H. P. Westinghouse double-flow gas producer equipped with wet and dry scrubbers, mixing and gas storage tank, and motor driven exhauster.

The engine room contains the following principal apparatus: 10 by 12 inch high speed Russell engine; 6 by 9 inch throttling Sturtevant engine; 75 K. W. De Laval Steam turbine geared to twin generators; 7 by 6 inch two-cylinder vertical Westinghouse Jr. engine; 15 by 14 inch three-cylinder vertical Westinghouse gas engine direct connected to alternator; 6¾ by 14 inch single Fairbanks, Morse & Company gas engine; 8¾ by 14 inch Priestman oil-engine; a J. George Leyner Engineering Works two-stage air compressor—capacity 275 cubic feet air per minute; and a small Westinghouse air-brake.

GENERAL INFORMATION.

EXPENSES.

TUITION.

The Statutes of Colorado provide as follows:

> "The said School of Mines shall be open and free for instruction to all bona fide residents of this State, without regard to sex or color, and, with the consent of the Board, students from other states and territories may receive education thereat upon such terms and at such rates of tuition as the Board may prescribe."

The tuition for non-residents is one hundred fifty dollars per year, payable in two instalments—seventy-five dollars at the beginning of each semester.

FEES AND DEPOSITS.

Deposits are required to cover the cost of supplies consumed, and any unused balance is returned. Fees are charged to cover not only the cost of materials furnished, but also the wear on apparatus and supplies. No part of a fee is returnable.

Matriculation Fee (Paid once only)	$5.00
Drawing Deposit (Paid once only)	2.00

A deposit of $15.00 is required in all Chemical Laboratory Courses, $25.00 in the Assaying Laboratory Course, $5.00 in the Ore Dressing Laboratory Course, and $5.00 in the Electrometallurgical Laboratory Course.

Freshman Year.

First Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee	.50
Qualitative Analysis Fee	10.00

Second Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee	.50
Qualitative Analysis Fee	20.00

SOPHOMORE YEAR.

First Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee	.50
Quantitative Analysis Fee	10.00
Mineralogy and Blowpipe Fee	15.00
Physical Laboratory Fee	5.00

Second Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee	.50
Quantitative Analysis Fee	10.00
Physical Laboratory Fee	5.00
Plane Surveying Fee	5.00

JUNIOR YEAR.

First Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee (Groups I., II. and III.)	.50
Assaying Fee	20.00
Quantitative Analysis Fee (Groups I., III. and IV.)	10.00
Electrical Laboratory Fee (Elective)	5.00

JUNIOR YEAR.

Second Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee (Groups I., II. and III.)	.50
Lithology Fee (Groups I. and IV.)	3.00
Assaying Fee	20.00
Mechanics of Engineering Laboratory Fee (Groups I. and II.)	5.00
Mine Surveying Fee (Groups I., II. and IV.)	5.00
Metallurgical Chemistry Fee (Group III.)	10.00
Quantitative Analysis Fee (Group IV.)	10.00
Electrical Laboratory Fee (Elective)	5.00

SENIOR YEAR.

First Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee	.50

Ore Dressing Fee	5.00
Gems and Gem Mining Fee (Elective)	3.00
Mining Laboratory Fee (Groups I. and II.)	5.00
Electrometallurgical Laboratory Fee (Group III.)	5.00
Metallurgical Chemistry Laboratory Fee (Group III.)	10.00
Metallurgical Laboratory Fee (Group III.)	5.00
Microscopic Petrography Laboratory Fee (Group IV.)	5.00
Thesis Fee	5.00

SENIOR YEAR.

Second Semester.

Athletic Fee	$ 5.00
Locker Fee	1.00
Drawing Fee (Elective)	.50
Hydraulic Laboratory Fee (Group I.)	2.00
Electrical Laboratory Fee (Group II.)	5.00
Coal and Gas Analysis Laboratory Fee (Group II.)	5.00
Metallurgical Laboratory Fee (Group III.)	5.00
Metallography Laboratory Fee (Group III.)	2.00
Geological Chemistry Fee (Group IV.)	10.00
Mechanical Engineering Laboratory Fee (Elective)	5.00
Ceramic Geology Fee (Elective)	3.00
Graduation Fee	6.00

TEXT-BOOKS AND STUDENTS' SUPPLIES.

The cost of text-books and students' supplies necessarily varies, but the following is a fair estimate:

Freshman Year:	Text-Books	$20.00
	Drawing Supplies	20.00
Sophomore Year:	Text-Books	20.00
Junior Year:	Text-Books	25.00
Senior Year:	Text-Books	30.00

BOARD AND LODGING.

The college has no dormitory. Board can be obtained in private families at from four to six dollars per week. Students' clubs furnish board at about eighteen dollars per month. Rooms can be obtained at from six dollars to twelve dollars per month.

OTHER EXPENSES.

There are other expenses incidental to the mining, metallurgical, and geological trips, which vary so widely that they cannot be estimated. The preparation of the Senior thesis also involves expenses which vary with the nature and treatment of the subjects.

For laboratory work in special cases a deposit of fifteen dollars is required. Students leaving in mid-term, except on account of severe protracted sickness, are not entitled to the return of fees or tuition. *All charges of the college are payable strictly in advance at the beginning of each semester.* No student is allowed to be graduated while indebted to the school. The Trustees reserve the right to make incidental changes in fees and deposits without printed notice, as new and unforeseen emergencies may arise.

Students who desire to earn money to defray their college expenses are advised to limit their work to the summer vacation. The course of study is too exacting to allow much time during the college year for outside work.

The total expenses of the college year, exclusive of tuition, need not exceed four hundred fifty dollars, and may, by strict economy, be considerably reduced.

METHOD OF GRADING.

The following system of grading is used:

- A—Excellent.
- B—Good.
- C—Fair.
- D—Conditioned.
- E—Failed.

A, B, and C are passing grades.

D (Conditioned) means that the student is not passed. The deficiency may be removed by passing an examination or otherwise completing the work. Unless a condition is removed before the beginning of the school year, following the year in which the condition is given, it becomes an E and the subject must be taken again.

E (Failed) means that the subject must be repeated and no advanced subject which depends upon this one can be taken until the E is removed.

A student who at any time has conditions, that is D's or E's, or both, amounting to a total of twelve hours' work a week, may not remove any of these conditions by re-examination, but must, in each case, repeat the course. In deciding whether a student has a total of twelve hours' conditions, all D's and E's will be counted, including old conditions left over from a previous semester.

A three hours' laboratory or drawing period is regarded as the equivalent of one hour's work. In case a student fails to complete his work the instructor returns to the office not a "D," but an "Incomplete," which is designated by the letters "Inc." This is not regarded as a condition in the sense used above.

No student may take any Junior subject until he has received credit in all Freshman subjects.

No student may take any Senior subject until he has received credit in all Freshman and Sophomore subjects.

In case of students admitted to advanced standing the two preceding rules may be suspended during the first year of their attendance, but all advanced standing students must take the regularly scheduled trips not covered by accepted credits at the earliest opportunity offered, and in any case before a degree is conferred.

VINSON WALSH RESEARCH DEPARTMENT.

On May 22, 1908, Thomas F. Walsh gave to the school the sum of one thousand dollars to establish the Vinson Walsh Research Department in memory of his son Vinson Walsh. Mr. Walsh afterwards increased the total amount to seven thousand dollars. With this fund a Rare Metal laboratory has been equipped and research work on the rare metals has been established.

THE QUARTERLY.

Four times a year—in January, April, July, and October—the School issues the Quarterly. The various numbers include the Catalog, the Book of Views, Commencement addresses. and articles of a mining or metallurgical nature.

PRIZES.

At the Commencement Exercises May 22, 1910, the following prizes were awarded:

Brunton Transit from D. W. Brunton, Denver, Colorado, and Slide Rule from Eugene Dietzgen Co., Chicago, Illinois, to Henry Gilman Skavlem and Harry Munson Showman. Thesis: A Topographical and Geological Survey of a Region West of Russell, Colo.

Fifty dollars from "Mines and Minerals" to Jean McCallum and Duane Carroll Kelso. Thesis: The Measurement of the Flow of Compressed Air by Means of an Orifice Meter.

Fifty dollars from "Mining and Scientific Press" to John Wesley Whitehurst and Webster Page Cary. Thesis: The Design of a Mine Plant Using Electrical Power with Fly Wheel Accumulator Set for Hoisting.

The "Edward G. Stoiber Prizes," Fifty dollars to Jean McCallum and Emil John Bruderlin. Thesis: The Design of a Dry Chlorination Plant.

One hundred twenty-five dollars to George McCrory Lee and Robert Mayro Keeney. Thesis: The Direct Manufacture in the Electric Furnace of Steels and Ferro-alloys.

THE INTEGRAL CLUB.

Each student, on entering the school, receives free of charge a membership card in the Integral Club. The Club Room is in the Gymnasium Building and is furnished in the ordinary style of a gentleman's club. The purpose of the club is to foster good comradeship among the students. The club is under the direct charge of a student committee.

Chairman, Emory M. Marshall, '11.
Donald Dyrenforth, '12.
Whitney Newton, Jr., '13.

SOCIAL LIFE.

Social life in the college is fostered by a committee of students consisting of three members from each of the four classes. The committee gives a reception about once a month.

President, Thomas H. Garnett, '11.
Secretary and Treasurer, Clarence E. Copeland, '12.

ATHLETIC ASSOCIATION.

By virtue of the athletic fee required of all students, all students entering the School of Mines become members of the Athletic Association. The association is supported by the students' fees, by gate receipts, and by contributions from the alumni and other friends of the college. The treasurer of the school, Harry M. Rubey, Woods-Rubey National Bank, selected by the Board of Trustees, is, *ex-officio*, treasurer of the association. The affairs of the association are managed by a board of control, which consists of seven members; three undergraduates elected by the students, an alumnus selected by the alumni association, and three members of the faculty elected by the faculty.

The Board of Athletic Control comprises:

Professor Arthur J. Hoskin, President.
Assistant Professor Charles D. Test, Vice-President.
Assistant Professor Charles E. Smith.
Arthur Hodgson, '99.
Edward J. Dittus, '11, Secretary.
Hugh D. Linn, '12.
Whitney Newton, Jr., '13.

The Athletic Association maintains an office in the Gymnasium under the supervision of the Athletic Director. The following are the athletic officials.

Captain Will C. Bryan, Athletic Director, Trainer, and Track Coach.

T. M. Stuart, Jr., Football Coach.

Burt Jones, Baseball Coach, and Keeper of the Grounds.

SPANISH.

In response to the demand from students who expect to pursue their vocation in Mexico, a private class in Spanish is conducted by José Antonio Paredes, of Mazatlan, Sinaloa, Mexico.

LIBRARY.

The library, which numbers more than ten thousand volumes and about fifty-five hundred pamphlets, is primarily of a technical nature and is being increased along lines corresponding with instruction in the college. Direct access to the shelves is permitted to all students in order that they may secure the benefit of examining the books themselves. Books which are not needed for special reference work are loaned for home use for a period of two weeks. The card catalogue includes entries under author, title, and subject, arranged on the dictionary plan. The classification is an adaptation of the Dewey decimal system to the needs of a technical library.

The library receives the publications of the leading scientific societies of the world, and the chief literary and scientific periodicals. It is especially rich in files of journals relating to the various branches of mining engineering, and receives as gifts the maps and various publications of the United States Geological Survey, a number of other United States documents, and reports of various state geological surveys and mining bureaus.

The library is open from 8 to 12 a. m., 1 to 5 p. m., and 7 to 9:30 p. m., with the exception of Sundays and legal holidays.

ALUMNI ASSOCIATION.

The Association of the Alumni holds its annual meeting and banquet on the day following the commencement exercises, unless otherwise provided for by the Executive Committee. All graduates holding degrees are eligible to membership and are invited to the annual meeting and banquet.

The aim of the Association is to promote acquaintance and friendship among the graduates, to encourage them to aid each other, and to make an organized effort to elevate and uphold the reputation and standard of their Alma Mater. To carry out these ideas, the Association, under the management of an Assistant Secretary, publishes monthly the Colorado School of Mines Magazine and conducts an Employment Bureau for the benefit of the members.

All graduates are earnestly requested to join the Association and to keep the Assistant Secretary advised as to their addresses and occupation.

The officers of the Association are:

Frederick S. Titsworth, '95, President.

Carl A. Allen, '05, Vice-President.

Arthur R. Hodgson, '99, Secretary.

Frederick C. Steinhauer, '99, Treasurer.

Executive Committee:—Lewis B. Skinner, '95; Junius W. Johnson, '01; Thomas P. Ellis, '07.

Jay Lonergan, '05, Assistant Secretary, Editor and Manager of the Colorado School of Mines Magazine.

Y. M. C. A.

The College Young Men's Christian Association is one of the 763 that are now organized in the Colleges and Universities of the United States and Canada. More than 61,000 college men are members of the organization, an increase of 85 per cent. in the past ten years.

The Y. M. C. A. of the Colorado School of Mines was organized in 1900; it has had a General Secretary since 1906; the membership has reached half of the student body and includes the leaders in scholarship, athletics, and fraternity life; it exists for the purpose of helping the men of the school in every possible way; at the beginning of the school year the new men are assisted in securing rooms and boarding places; an employment bureau is conducted throughout the year. The "Mines Hand Book" is published annually and distributed without charge to the students, alumni, and prospective students. It gives a detailed account of the various activities of the Christian Association which include Bible Study, Mission Study, Religious Meetings, Social affairs, and a course of five popular entertainments. A copy of this book will be sent upon application to the General Secretary.

An Advisory Board, consisting of two Faculty members, one alumnus, one minister, and one business man, supervises the work of the Association. The present members are: Professor Herman Fleck, Professor Charles R. Burger, Clare L. Colburn, '07; Rev. Ira D. Hall, and George W. Parfet.

The officers for 1910-11 are: President, Ralph V. Thurston, '11; Vice-President, Walter C. Huntington, '12; Secretary, Arnold W. Harris, '12; Treasurer, Charles D. Grier, '12; General Secretary, James B. Watson, Pennsylvania State College, '09.

SCIENTIFIC SOCIETY.

The Scientific Society has for its object the presentation and discussion of technical and engineering subjects. From time to time, lectures are delivered before the society by the leading authorities on various topics of interest to its members and friends. The selection of these addresses is placed in the hands of an executive committee chosen from the Senior and Junior classes. All lectures are held in Simon Guggenheim Hall, on such nights as are most convenient for the majority of the students. The proceedings of the society are printed in "The Colorado School of Mines Magazine." The Alumni, Faculty, Senior and Junior classes of the institution constitute the active members of the organization; the Sophomores and Freshmen are associates.

The officers for the year 1910-11 are:

Emory M. Marshall, '11, President.

Ralph V. Thurston, '11, Vice-President.

John V. Harvey, '11, Secretary.

Samuel R. Brown, '11, Treasurer.

Executive Committee:—Robert E. Snow, '11; Edward J. Dittus, '11; Otto Herres, Jr., '11; Joe H. Woolf, Jr., '12; Edward D. Wilcoxson, '12; Elmer R. Ramsey, '12.

ENROLMENT OF STUDENTS.

POSTGRADUATE STUDENTS.

Anderson, Robert . . . . . . *Cecilton, Md.*
A. B. St. John's College.

Andrews, Earle D. . . . . . . *La Junta, Colo.*
B. C. E. Iowa State College.

Bettles, Gordon M. . . . . . . *Salt Lake, Utah*
C. E. Pennsylvania Military College.

Bisland, John B. . . . . . . *Houma, La.*
B. S. Louisiana State University.

Campbell, Ray C. . . . . . . *Dallas, Texas*
C. E. Pennsylvania Military Academy.

Greene, John V. . . . . . . *Liberty, Mo.*
A. B. William Jewell College.

Harris, Gabriel G. . . . . . . *Joliet, Ill.*
A. B. Lake Forest College.

Heaton, Charles D. . . . . . . *Rochester, N. Y.*
A. B., M. Sc. University of Rochester.

Hilsdale, W. O. Paul . . . . . . *Sauk Center, Minn.*
A. B. Yale College.

Hudson, Walter C. . . . . . . *Lancaster, Ky.*
A. B. Central University of Kentucky.
A. M. Princeton University.

Keeney, Robert M. . . . . . . *Somersville, Conn.*
E. Met. Colorado School of Mines.

Koch, William F. . . . . . . *Chicago, Ill.*
A. B. St. Ignatius College.

Ledbetter, Raymond D. . . . . . . *Lestershire, N. Y.*
A. B. Amherst College.

Matteson, Wallace G. . . . . . . *Syracuse, N. Y.*
B. S. Syracuse University.

Mertes, Albert T. . . . . . . *Traverse City, Mich.*
B. S. University of Notre Dame.

Rockwood, Carl A. . . . . . . *Granville, Ohio*
B. S. Denison University.

Schellenberg, Gustave Wm. . . . . *Wheeling, W. Va.*
C. E. Ohio Northern University.

Thayer, William H. . . . . *Wichita, Kansas*
A. B. Fairmount College.

Thurstin, Robert A. . . . . *Holly, Colo.*
B. Sc. Kenyon College.

Tomlinson, L. C. . . . . *Oak Park, Ill.*
E. E., M. S. University of Minnesota.

Villalobos, Gumaro. . . . . *Encarnacion, Jalisco, Mexico*
Columbia University.
Ph. D. Gregorian University, Rome.

Watson, James B. . . . . *Indiana, Pa.*
B. S. Pennsylvania State College.

CLASS OF 1911.

SENIOR CLASS.

President, Thomas H. Garnett.
Vice-President, Karl V. Geib.
Secretary and Treasurer, Walter J. Mayer.

Andre, Morris V., Jr.	*Guanajuato, Mexico*
Baker, Hamilton W.	*Iloilo, P. I.*
Banks, Leon M.	*Denver, Colo.*
Barnett, Walter W.	*Golden, Colo.*
Blum, Sidney	*Pueblo, Colo.*
Bowman, Reginald G.	*Washington, D. C.*
Brown, Samuel R., Jr.	*Montrose, Colo.*
Brugger, Albert E.	*Columbus, Nebr.*
Clausen, Samuel J., Jr.	*Clear Lake, Iowa*
Dittus, Edward J.	*Colorado Springs, Colo.*
University of Wisconsin.	
Douglas, William C.	*Plainfield, N. J.*
Engle, Frederick	*Denver, Colo.*
University of Colorado.	
Fullerton, Wilfred	*Denver, Colo*
Galligan, J. T.	*Idaho Springs, Colo.*
Garnett, Thomas H.	*Pueblo, Colo.*
Geib, Karl V.	*Denver, Colo.*
Harvey, John V.	*Sioux City, Iowa*
Herres, Otto, Jr.	*Denver, Colo.*
Lannon, James A.	*Pueblo, Colo.*
University of Colorado.	
Laurence, B. M.	*San Bernadino, Calif.*
Lee, Frank W., Jr.	*Denver, Colo.*
Marshall, Emory M.	*Des Moines, Iowa*
Iowa State College. University of Wisconsin.	

Matheson, Kenneth H.	*Hugo, Colo.*
May, Arthur L. Geneva College.	*Beaver Falls, Pa.*
Mayer, Walter J.	*Leadville, Colo.*
McHugh, Phil M.	*Aberdeen, S. D.*
Olsen, Charles O.	*Spokane, Wash.*
Schneider, August W.	*Arvada, Colo.*
Shaw, Ralph H.	*Aspen, Colo.*
Smith, Roy F.	*Denver, Colo.*
Snow, Robert E.	*Greenwood, Colo.*
Thurston, Ralph V.	*Payette, Idaho*
Voelzel, Gustave W.	*Denver, Colo.*
Williams, Irving B.	*Golden, Colo.*
Wraith, Charles R.	*Anaconda, Mont.*
Zwetow, Arthur N.	*Denver, Colo.*

CLASS OF 1912.

JUNIOR CLASS.

President, Hugh D. Linn.
Vice-President, C. R. Hill.
Secretary, Verne R. Langdon.
Treasurer, Frank B. Harris.

Ball, Byron E.	*Birmingham, Ala.*
Georgia Institute of Technology. Northwestern University.	
Beck, Daniel L.	*Denver, Colo.*
Benner, Howard C.	*Golden, Colo.*
Benson, Paul T.	*Denver, Colo.*
Bicknell, Frank P.	*Denver, Colo.*
University of Colorado.	
Bowhay, A. A., Jr.	*Denver, Colo.*
Boyle, Willis J., Jr.	*Los Angeles, Calif.*
Bronstein, Charles N.	*Denver, Colo.*
Brooke, F. L.	*Los Angeles, Calif.*
Brunel, Frank	*Golden, Colo.*
Calvert, Clarence E.	*Golden, Colo.*
Copeland, Clarence E.	*Los Angeles, Calif.*
Currens, Warren W.	*Denver, Colo.*
Curtis, Harry C.	*Littleton, Colo.*
Davenport, John	*Boston, Mass.*
Harvard University.	
Davis, Charles A.	*San Bernadino, Calif.*
Dick, James E.	*Akron, Ohio*
Buchtel College.	
Dugan, William F.	*Minneapolis, Minn.*
University of Notre Dame.	
Dunn, James L.	*Minneapolis, Minn.*
Dyrenforth, Donald	*Chicago, Ill.*
Emrich, Jay L.	*Golden, Colo.*
Erickson, Guy W.	*Ouray, Colo.*
Fay, Charles H.	*Wyoming, Ohio*
Field, Edmund M.	*Kansas City, Mo.*

Forbes, Henry H. .... *Westboro, Mass.*
Cornell University.
Frazee, Verne.................................. *Moweaqua, Ill.*
Gaul, John C................................... *Calumet, Mich.*
Michigan College of Mines.
Geary, Ernest S................................ *Denver, Colo.*
Greensfelder, Nelson S......................... *Clayton, Mo.*
Colorado College.
Grier, Charles D............................... *Denver, Colo.*
Hager, Edward T. .... *Ft. Atkinson, Wis.*
Hand, Edwin E., Jr............................. *Chicago, Ill.*
Armour Institute of Technology.
Harris, Arnold W. .... *Denver, Colo.*
Harris, Frank B................................ *Denver, Colo.*
Hemphill, Earl A............................... *Denver, Colo.*
Denver University.
Hiester, Arthur J............................... *Chicago, Ill.*
Hill, Charles R................................. *New York, N. Y.*
Sheffield Scientific School.
Hughes, Earle E................................ *Denver, Colo.*
Huntington, Walter C........................... *Denver, Colo.*
Jones, Lodeman E............................... *Denver, Colo.*
Kissock, Alan.................................. *New York, N. Y.*
Langdon, Verne R............................... *Littleton, Colo.*
Leahy, Richard A............................... *Golden, Colo.*
Troop Polytechnic Institute.
Linn, Hugh D. .... *Golden, Colo.*
MacKay, Donald R............................... *Golden, Colo.*
Major, Finley A................................ *Creede, Colo.*
May, Andrew J., Jr. .... *Tazewell, Va.*
May, Ross R. .... *Denver, Colo.*
Meents, Richard O.............................. *Golden, Colo.*
Iowa State College.
Neiswender, Chester B. .... *Los Angeles, Calif.*
University of Southern California.
Oram, Charles F. .... *Golden, Colo.*
Peregrine, William D........................... *Golden, Colo.*
Place, J. Sterling .... *Orange, N. J.*
Pennsylvania State College.
Porter, Phillip W............................... *Higganum, Conn.*
Ramlow, William G.............................. *St. Paul, Minn.*
University of Minnesota.
Ramsey, Elmer R................................ *Denver, Colo.*
Reed, Charles H. .... *Denver, Colo.*
Richardson, Allan S............................ *Montreal, Canada*
Colorado College.
Robbins, Virgil C. .... *Rochester, Ind.*
Roberts, Henry M............................... *Denver, Colo.*
University of Colorado.

Rusman, Ben A. ....*Denver, Colo.*
Saunders, Frank H...........................*Gloversville, N. Y.*
Columbia University.
Saxton, Frank B.................................*Pueblo, Colo.*
Schmidt, Carl H. ....*Brush, Colo.*
University of Michigan.
Smith, Warren D. ....*Deposit, N. Y.*
Spring, Archer ....*Boston, Mass.*
Stewart, Hugh A. ....*Denver, Colo.*
Thomas, Lester C. ....*Denver, Colo.*
Toenges, Albert L. ....*Dayton, Ohio*
Walker, Alexander D. ....*Cripple Creek, Colo.*
Walker, Stanley M. ....*Denver, Colo.*
Weller, Simon T. ....*Denver, Colo.*
Whitehead, Paul..................................*Denver, Colo.*
Wilcoxson, Edward D.............................*Pueblo, Colo.*
Woolf, Joe H., Jr.................................*Greeley, Colo.*
Youker, C. Norman...............................*Golden, Colo.*

CLASS OF 1913.

SOPHOMORE CLASS.

President, Alfred Flinn.
Vice-President, George Wilfley.
Secretary, Howard C. Smith.
Treasurer, John F. Myers.

Ailinger, Walter J.	*Denver, Colo.*	
Arfsten, George J.	*Denver, Colo.*	
Arthur, Charles S.	*Denver, Colo.*	
Bear, Simon L.	*Allegheny, Pa.*	Lehigh University.
Bicknell, Harold L.	*Oak Park, Ill.*	
Bigley, Arthur C.	*Golden, Colo.*	
Billyard, John R. H. H.	*Valparaiso, Chili, S. A.*	
Bregman, Adolph	*Brooklyn, N. Y.*	
Cadot, John J.	*Chicago, Ill.*	
Cain, Louis S.	*Denver, Colo.*	
Chapman, Irving A.	*Brooklyn, N. Y.*	
Crawford, Clarence C.	*Pueblo, Colo.*	
Cronin, Harry M.	*Denver, Colo.*	
Crutcher, Ernest R.	*Salida, Colo.*	
Dale, George K.	*Oshkosh, Wis.*	University of Wisconsin.
Daman, C. J.	*Napoleon, Ohio.*	Ohio Northern University.
Dammann, Arthur C.	*Chicago, Ill.*	Lewis Institute.
Daniels, Robert M.	*Denver, Colo.*	University of Colorado.
Dauth, Herman	*Denver, Colo.*	
Davis, Harold	*Scranton, Pa.*	U. S. Naval Academy.
Davis, John R.	*Denver, Colo.*	
Dove, Dean R.	*Denver, Colo.*	
Downes, Frank A.	*Idaho Springs, Colo.*	
Dudgeon, James W.	*Denver, Colo.*	
Eaton, Walter J.	*Santa Ana, Calif.*	

Flinn, Alfred .... *Duluth, Minn.*
Frame, James .... *Newport, R. I.*
Dartmouth College.
Frankel, Jacob M. .... *New York, N. Y.*
French, Clare L. .... *Rifle, Colo.*
Colorado Agricultural College.
Glendenning, J. Inglis, Jr. .... *Denver, Colo.*
Goldsborough, Thaddeus R. .... *Washington, D. C.*
Dartmouth College.
Gosset, Gordon M. .... *London, England*
Gregg, Daniel B. .... *Cincinnati, Ohio*
University of Cincinnati.
Gwillim, Edward C. .... *Colorado Springs, Colo.*
Colorado College.
Hammond, Herbert R. .... *Montclair, Colo.*
Heinrichs, Walter E. .... *Pittsburg, Pa.*
Ho, Chieh .... *Poo ting foo, China*
Tangshan Engineering and Mining College.
Hugo, Herman W. .... *Indianapolis, Ind.*
Kilbourn, Burwell N. .... *Pueblo, Colo.*
Klatt, Carl L. .... *Golden, Colo.*
Lake, Gordon B. .... *Waterbury, Conn.*
Light, Victor A. .... *Wheatridge, Colo.*
Litchfield, Rufus E. .... *Fitchburg, Mass.*
Martinez, Fidel .... *Ocampo, Coahuila, Mexico*
Rensselaer Polytechnic Institute.
Mathews, Harvey .... *Eden, Colo.*
McCurry, John A. .... *Parsons, Kansas*
McGregor, Merwyn S. .... *Maywood, Ill.*
McGuire, Philip J. .... *Denver, Colo.*
McNeil, Neil M. .... *Chicago, Ill.*
McNicholas, Frederick S. .... *Durango, Colo.*
Miller, Charles A. .... *Grand Junction, Colo.*
Miller, Roy H. .... *Canon City, Colo.*
Minister, Howard L. .... *Canon City, Colo.*
Moll, Claude D. .... *Decatur, Ill.*
Myers, John F. .... *Winona Lake, Ind.*
Neely, Frank S. .... *Memphis, Tenn.*
University of Tennessee.
Newton, Whitney, Jr. .... *Denver, Colo.*
University of Colorado.
Nieman, E. F. .... *Salt Lake, Utah*
Nolan, Philip E. .... *Green Bay, Wis.*
Osburn, Charles M. .... *Paonia, Colo.*
Paredes, José Antonio .... *Matzatlan, Sinaloa, Mexico*
University of Denver.
Pratt, Allyne F. .... *Portland, Ore.*
Oregon Agricultural College.

Price, Harold C. .... *Washington, D. C.*
Prior, Charles E., Jr. .... *Plainfield, N. J.*
Ransom, Rastus S., Jr. .... *New York, N. Y.*
Columbia University.
Reed, Sydney .... *Denver, Colo.*
Roberts, Keith .... *Wilmette, Ill.*
Root, William E. .... *Denver, Colo.*
Sieg, Walter J. .... *Golden, Colo.*
Smith, Howard C. .... *Cripple Creek, Colo.*
Soloman, Irwin R. .... *St. Louis, Mo*
University of Colorado.
Stein, Edmund .... *San Antonio, Texas*
Stewart, Allister K., Jr. .... *St. Louis, Mo.*
Stockder, Hans J. .... *Canon City, Colo.*
Stronck, Hubert N. .... *Le Mars, Iowa*
Strong, Earle A. .... *Oneonta, N. Y.*
Swanson, C. Arthur .... *Golden, Colo.*
Taylor, Lemuel K. .... *Wheeling, W. Va.*
U. S. Naval Academy.
Truehart, Lawrence G. .... *San Antonio, Texas*
Wang, Shao-ying .... *Canton, China*
Tangshan Engineering and Mining College.
Ward, Merwin H. .... *Everett, Mass.*
Massachusetts Institute of Technology.
Warren, Seymour P. .... *Denver, Colo.*
Watrous, Mark U. .... *Monte Vista, Colo.*
Watson, Samuel E. .... *Clarksville, Texas*
Wheelock, Harold F. .... *Denver, Colo.*
Wilfley, George .... *Denver, Colo.*
Wilkinson, Mearle W. .... *Denver, Colo.*
Williams, John C. .... *Denver, Colo.*
University of Denver.
Wilson, Harry R. .... *Denver, Colo.*
Woods, Frank M., Jr. .... *Colorado Springs, Colo.*
Young, Peter A. .... *Huron, S. D.*
Zuleh, William G. .... *Denver, Colo.*

CLASS OF 1914.

FRESHMAN CLASS.

President, Crit C. Tolman.
Vice-President, Stanton E. Winston.
Secretary, Russell P. Luke.
Treasurer, Frank L. Pitman.

Acker, Joseph C.	*Bethlehem, Pa.*
Lehigh University.	
Baker, Erwin F.	*Denver, Colo.*
Bayly, Taver	*Atlanta, Ga.*
Beam, John W.	*Denver, Colo.*
Beamer, Frederick L.	*Golden, Colo.*
Bebee, Alfred H.	*Cripple Creek, Colo.*
Beck, Wm. Lloyd	*Denver, Colo.*
Bissell, Karl H.	*New York, N. Y.*
Boehmer, Max, Jr.	*Denver, Colo.*
Amherst College.	
Bohn, Robert G.	*Grand Island, Nebr.*
Bolam, Albert E.	*National, Nevada*
Bowen, George E.	*Leadville, Colo.*
Brainerd, W. M.	*Norwood, Colo.*
Brousseau, Andrew R.	*New Orleans, La.*
Brown, Clarence W.	*Littleton, Colo.*
Brugger, Melvin	*Columbus, Nebr.*
Bryant, Routt A.	*Denver, Colo.*
Buesco, Manuel, Jr.	*Santa Rosa, Honduras, C. A.*
Burns, Jay	*Franklin, Pa.*
Bussert, Leonardo	*Los Angeles, Calif.*
Cadwell, Howard O.	*Watertown, N. Y.*
Callahan, Thomas W.	*Golden, Colo.*
Carruthers, Albert S.	*Fairbanks, Alaska*
Chase, Frank H.	*Denver, Colo.*
Chen, Ye-fah	*Shanghai, China*
Cheng, Dah-Chun	*Kiang Yin, Kiangsu, China*
Fu-tan College.	
Chung, Jewhan	*Seoul, Korea*
Clark, Chester G.	*Denver, Colo.*

Clark, George W. . . . . *Sedro-Woolley, Wash.*
Clark, Louis F. . . . . *Grand Rapids, Mich.*
Collins, A. E. Gerald . . . . *Denver, Colo.*
Craig, Allan E. . . . . *Denver, Colo.*
Crampton, Theodore H. M. . . . . *Golden, Colo.*
Culbertson, James W. . . . . *Austin, Texas*
Davis, Gilmore S. . . . . *Trinidad, Colo.*
De Laittre, Horace H. . . . . *Minneapolis, Minn.*
Dowden, Ethelbert, Jr. . . . . *Plainview, Texas*
Ellis, Shirley D. . . . . *Victoria, B. C.*
Essig, Benjamin C. . . . . *Owosso, Mich.*
Michigan Agricultural College.
Finkelstein, Benjamin . . . . *Denver, Colo.*
Fischer, Oscar A. . . . . *Chicago, Ill.*
Foo, Shu . . . . *Chung Ching, Szechuen, China*
Fu-tan College.
Glerum, Louis A. . . . . *Devil's Lake, N. D.*
Grant, Bertram . . . . *Philadelphia, Pa.*
Graves, Harry M. . . . . *Tioga, Colo.*
Graybeal, Edward V. . . . . *Pueblo, Colo.*
Grigsby, Gail G. . . . . *Denver, Colo.*
Harding, Justin W. . . . . *Franklin, Ohio*
Harper, Robert R. . . . . *Des Moines, Iowa*
Haselton, Charles F. . . . . *Chicago, Ill.*
Heatley, F. Eugene . . . . *Denver, Colo.*
Hudson, Havard F. . . . . *Wichita, Kansas*
Hutton, Meritt . . . . *Denver, Colo.*
Jackling, John R. . . . . *Berkeley, Calif.*
Johnson, Byron P. . . . . *Prince Rupert, B. C.*
Johnson, John B. . . . . *Wheeling, W. Va.*
Washington and Jefferson College.
Kao, Tsung-Te . . . . *Temple Hill, Chefoo, China*
Shantung Union College.
Kaufman, Sidney . . . . *Denver, Colo.*
Keyser, Allen D. . . . . *Joppa, Md.*
Baltimore Polytechnic Institute.
Koelker, Karl L. . . . . *Toledo, Ohio*
Purdue University.
Krohn, Arthur . . . . *Chicago, Ill.*
Kwong, Yih-Kun . . . . *Kuang tung, China*
St. John's University.
Lee, Arthur L. . . . . *Johnstown, Colo.*
Lee, Ping . . . . *Wu-Sih, Kiangsu, China*
Imperial College of Peking.
Luke, Russell P. . . . . *Edwardsville, Pa.*
Mann, Paul C. . . . . *Denver, Colo.*
University of Colorado.
Mellen, George Z. . . . . *Victor, Colo.*

Merry, Frank P. .... *Baltimore, Md.*
Baltimore Polytechnic Institute.
Navario, Carlos V. .... *Allende, Coahuila, Mexico*
Orr, David H. .... *Stone Bridge, Clones, Ireland*
Parker, Nathan H. .... *Trinidad, Colo.*
Peale, Richard .... *St. Benedict, Pa.*
Pearce, James W. .... *Denver, Colo.*
University of Colorado.
Peeler, Grady .... *Campbellton, Texas*
Pittman, Frank L. .... *Tacoma, Wash.*
Reynolds, Elsbery W., Jr. .... *Morgan Park, Ill.*
Robinson, Orlie W. .... *Clarksburg, W. Va.*
Rogers, Charles A. .... *Salida, Colo.*
Rogers, Phillip E. .... *Aroya, Colo.*
Rosette, Breese .... *De Kalb, Ill.*
Sallen, Edward W. .... *Denver, Colo.*
Scott, Clarence R. .... *Wamego, Kansas*
South Dakota School of Mines.
Shaw, Carl R. .... *Aspen, Colo.*
Shum, Nim Chi .... *Hongkong, China*
Simon, William W. .... *Canon City, Colo.*
Leland Stanford Jr. University.
Slattery, Frank E. .... *Silverton, Colo.*
Smith, Albert W. .... *Pueblo, Colo.*
Smith, Ralph W. .... *Denver, Colo.*
Snedaker, Eugene G. .... *Denver, Colo.*
Temple, Henry M. .... *Denver, Colo.*
Thompson, C. Lynn .... *Basin, Wyoming*
Tolman, Crit C. .... *Seward, Alaska*
University of Washington.
Turner, John H. .... *Golden, Colo.*
Valenzuela, Alonzo V. .... *Comayagua, Honduras, C. A.*
Van Dolah, Parks B. .... *Victor, Colo.*
Colorado Agricultural College.
Wade, Harry J., Jr. .... *Pocatello, Idaho*
Welsh, Madison F. .... *Kansas City, Mo.*
Whitaker, Charles N., Jr. .... *Golden, Colo.*
Wilfley, Elmer R. .... *Denver, Colo.*
Winston, Stanton E. .... *Longmont, Colo.*
Wolfe, Harlan B. .... *Eaton, Colo.*
Wood, Fletcher H. .... *Mt. Vernon, N. Y.*
Sheffield Scientific School.
Wuensch, Charles E. .... *Newark, N. J.*
Yang, Wei-Tsing .... *Cheng Tu, Sze Chuan, China*
Fu-Tan College.
Zisch, J. Henry .... *Denver, Colo.*

SUMMARY.

Postgraduates	22
Seniors	36
Juniors	76
Sophomores	92
Freshmen	105
Total	331

ALUMNI.

Abel, Walter D., '06.................... *Guanajuato, Gto., Mexico*
Adami, Charles J., '99.......................... *Flat River, Mo.*
Mining Superintendent, Federal Lead Co.
Adams, Charles, '04.......................... *Rhyolite, Nev.*
Montgomery Shoshone Mines Co.
Adams, Wilber E., '00.
Deceased.
Aldrich, Harold W., '06............ *420 Main St., Anaconda, Mont.*
New Reduction Works, Anaconda Copper Mining Co.
Allen, Carl A., '05................. *614 Ideal Bldg., Denver, Colo.*
Allen and Colburn, Mining Engineers.
Allen, Maynard C., '06.......................... *Hailey, Idaho*
U. S. Forest Service.
Aller, Frank D., '92. . *Cascilla 35, Antofagasta, Chili, South America*
Ambrosius, Carl E., '88.............. *Guanacevi, Durango, Mexico*
Anderson, Axel E., '04...................... *Wilmington, Del.*
E. I. Du Pont de Nemours Powder Co.
Anderson, Neil A., '02....................................
Armington, H. C., '07.......................... *Ogilby, Calif.*
United Mines Co.
Arthur, Edward P., '95...................... *Cripple, Creek, Colo.*
U. S. Mineral Surveyor.
Atkins, Horace H., Jr., '94................ *Hillsboro, New Mexico*
Statehood Mines Co.
Atkinson, Walter J., '96....................................
Atwater, Maxwell W., '01...................... *Butte, Montana*
Superintendent, Butte and Superior Mine.
Austin, Arthur, '05............... *708 Locust St., Anaconda, Mont.*
New Reduction Works, Anaconda Copper Mining Co.
Badger, Herbert E., '02............. *920 Ninth Ave., Greeley, Colo.*
Badgley, Charles W., '06.......... *1730 Franklin St., Denver, Colo.*
Assistant Superintendent of Mill, Western Chemical Mfg. Co.
Bailey, E. W., '05.............. *309 McPhee Building, Denver, Colo.*
Ball, Louis R., '00........................ *Fort Des Moines, Iowa*
Captain, U. S. A.
Ball, Max W., '06............................ *Washington, D. C.*
U. S. Geological Survey.
Ballagh, J. Courtenay, '10................. *Yzatal, Sonora, Mexico*
El Tigre Mining Co.
Barbour, Percy P., '98....................... *Idaho Springs, Colo.*
Stevens, Barbour & Co., Mining Engineers.

Barensheer, William J., '96.
333 Railway Exchange Building, Denver, Colo.
Chief Engineer, Grand River, Meeker and Salt Lake R. R.
Barker, Franklin L., '06............................*Eugene, Ore.*
Professor of Mining and Metallurgy, University of Oregon.
Barker, Pierce, '07................*500 Maple St., Anaconda, Mont.*
New Reduction Works, Anaconda Copper Mining Co.
Barnes, Corrin, '96............................*Goldfield, Nevada*
Barron, Chauney T., '02..........*San Luis Potosi, S. L. P., Mexico*
Bartholomew, Tracy, '06..............*508 Ideal Building, Denver*
The Western Cement Products Co.
Bastanchury, G. A., '07.........................*Fullerton, Calif.*
Beeler, Henry C., '96.................*222 Boston Building, Denver*
Mining Engineer.
Bell, Charles N., '06..............................*Ouray, Colo.*
Ingersoll & Bell, Mining Engineers.
Bellam, Henry L., '89......................*Box 686 Reno, Nevada*
Benjovsky, T. D., '09.............................*Silverton, Colo.*
Yukon Tunnel Co.
Benwell, George A., Jr., '00.
Deceased.
Bergh, John E., '02...
Berry, Albert, '05................*3221 First Ave., Spokane, Wash.*
Bertschy, Perry H., '98.........................*Deadwood, S. D.*
Superintendent, Imperial Mill.
Bishop, Raymond, '01.
Deceased.
Blackburn, Ward W., '08..........................*Tokio, Japan*
Takato and Co.
Block, Gary E., '08..............................*Prescott, Ariz.*
Blumenthal, Emil E., '98.....................*Phillipsburg, Mont.*
Granite Bimetallic Mining Co.
Bowie, James W., '94.
Deceased.
Bowman, Frank C., '01............*213 Boston Bldg., Denver, Colo.*
Mining Engineer.
Boyd, Jesse T., '08...............................*Ouray, Colo.*
Camp Bird Mines.
Bradford, Albert H., '09.........................*Placentia, Calif.*
Bradford, Julius S., '10...........................*Mancos, Colo.*
Doyle Consolidated Mining Co.
Bradley, Joseph M., '01...............................*Austin, Nev.*
Mining Engineer.
Brandt, A. R., '07.....................*820 Elati St., Denver, Colo.*
Breed, Charles F., '01..
Brinker, Arthur C., '01..............................*Ouray, Colo.*
Metallurgist, Camp Bird Mill.
Brinker, Albert W., '08.
Deceased.

Brooks, Eugene C., '10................*38 Lincoln St., Boston, Mass.*
Brown, Leroy C., '08..................................*Golden, Colo.*
Brown, John B., '06..............*Apartado 128, Pachuca, Mexico*
    Brown and Ames, Mining Engineers.
Brown, Norton H., '92.......................*Idaho Springs, Colo.*
    U. S. Mineral Surveyor.
Brown, R. L., '05..........................*Box "O," Auburn, Ala.*
    Professor of Mining and Geology, Alabama Polytechnic Institute.
Brown, Walter R., '10...............................*Ruth, Nevada*
    Nevada Consolidated Copper Co.
Bruce, Harry F., '00.
Bruce, James L., '01........................*Box 462, Joplin, Mo.*
    General Manager, Continental Zinc Co.
Bruce, Stewart S., '99...........................*Houghton, Mich.*
    Professor of Metallurgy, Michigan College of Mines.
Bruderlin, Emil J., '10............*1276 Emerson St., Denver, Colo.*
Brunel, Rene L., '06......................*Box 839, Goldfield, Nev.*
Bryan, Russell R., '08...............................*Golden, Colo.*
Bucher, John W., '02...........*3330 Tennyson St., Denver, Colo.*
    Chief Engineer, Colorado Iron Works Co.
Buck, Arthur H., '97...
Budrow, William B., '92...*Calle Hidalgo 1147, Guadalajara, Mexico*
Buell, Arthur W., '08.
    The Newberry Club, Box 336, Guayaquil, Ecuador, So. Amer.
    South American Development Co.
Bumsted, Edward J., '01...*Taviche District, Ocatlan, Oaxaca, Mexico*
    Manager, Tehauntepec Silver Mines Co.
Bunger, Milne E. '09..............................*Edgewater, Colo.*
Burgess, Charles W., '09..................*Box 465, Webb City, Mo.*
    Manager, Calhoun Lead and Zinc Co.
Burlingame, Walter E., '01................*Box 1520, Denver, Colo.*
    E. E. Burlingame & Co., Chemists and Assayers.
Busey, A. P., Jr., '05........*Campo Seco, Calaveras Co., California*
    Manager, Penn. Chemical Co.
Bussey, Edwin E., '97......*136 Florissant St., Cripple Creek, Colo.*
Butler, G. Montague, '02............................*Golden, Colo.*
    Assistant Professor of Geology and Mineralogy, Colorado School of Mines.
Campbell, Kent P., '10................*Velardena, Durango, Mexico*
    A. S. and R. Co.
Canning, Herbert A., '97.......................................
Canning, Walter E., '09......................*Prairie City, Oregon*
    Engineer, Iowa Copper Co.
Carman, John B., '10..................*Velardena, Durango, Mexico.*
    A. S. and R. Co.
Carney, Hugh J., '04...........*304 Boston Building, Denver, Colo.*
    Spurr and Cox.
Carpenter, Cranston H., '09......................*Leadville, Colo.*
    Arkansas Valley Smeltery.

Carpenter, Paul H., '10..............*494 E. State St., Sharon, Pa.*

Carstarphen, F. C., '05..........*517 Ideal Building, Denver, Colo.*

Cary, Webster P., '10.........................*Kingman, Arizona*

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Chamberlin, W. O., '05................*200 Pearl St., Denver, Colo.*

Chandler, John W., Jr., '01.......*69 Bacon Block, Berkeley, Calif.*

Birchville Mining Co.

Chapman, Thomas L., '06............*922 Tenth St., Denver, Colo.*

Charles, Lavern J., '02....*14 South Eighth St., No. Yakima, Wash.*

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Chedsey, William R., '08........................*Moscow, Idaho*

Associate Professor of Mining, University of Idaho.

Christensen, Walter, '02....................................

Church, Myron J., '98....*Park St. and 15th Ave., Milwaukee, Wis.*

Davis Manufacturing Co.

Clapp, Leroy P., '09...........*South Yarra, Melbourne, Australia*

Clark, George B., '01. ....*1614 Lake Ave., Pueblo, Colo.*

Clark, Winfred N., '98............................*Victor, Colo.*

Superintendent, Pueblo and Suburban Traction and Lighting Co.

Cline, Seymour F., '08...........*116 Vennum Ave., Mansfield, Ohio*

Coghill, Will H., '03............................*Evanston, Ill.*

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Cohen, Louis, '97..............*417 Jackson Building, Denver, Colo.*

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Allen and Colburn, Mining Engineers.

Cole, Burt, '92...................................*Tecumseh, Ala.*

Superintendent, Tecumseh Iron Co.

Coleman, R. Prewitt, '03.

Deceased.

Collbran, Arthur H., '02.......................*Pyeng Yang, Korea*

Manager, Suan Mine.

Collins, Philip M., '93..........................*Leadville, Colo.*

American Zinc Extraction Co.

Collins, Shrive B., '01................*Amethyst P. O., Creede, Colo.*

Mining Engineer.

Comstock, Charles W., '90............*State Capitol, Denver, Colo.*

State Engineer.

Corry, Arthur V., '98............*23 Silver Bow Block, Butte, Mont.*

Mining Engineer.

Corson, N. G., '07................................*Creede, Colo.*

Mining Engineer.

Cory, J. J., '05.....................*384 So. Pearl St., Denver, Colo.*

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Mechanical Engineer, Belmont Mining Co.

Cox, W. Ray, '02..............*R. F. D. No. 1, Box 24a, Ault, Colo.*

Craigue, William H., '89........................*Rhyolite, Nevada*

Cramer, Curtis P., '99............................*Fierro, N. M.*

Superintendent Emma Mine, Copper Queen Consolidated Mining Co.

Crow, Wade L., '01.
Deceased.
Crowe, Thomas B., '00.............................*Victor, Colo.*
Superintendent, New Portland Mill.
Cuno, A. F., '05...................*1727 Champa St., Denver, Colo.*
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D'Arcy, R. L., '05..........................*Grand Valley, Colo.*
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Davis, Carl R., '95...........*Krugersdrop, Transvaal, South Africa*
General Manager, Lancaster Gold Mining Co., Ltd.
Davis, Gilbert L., '99.......................*Ridgelawn, Montana*
U. S. Reclamation Service.
De Camp, W. Val, '08......................*Harrington, Arizona*
Pacific Copper Mining Co.
De Cou, Ralph E., '01.............................*Ouray, Colo.*
Camp Bird Mill.
De Sollar, Tenney C., '04.................*Box 45, Hancock, Mich.*
Mining Engineer, Quincy Mining Co.
Devinney, George V., '03.
Deceased.
Dilts, Ira J., '08.................................*Concrete, Colo.*
Chemist, Portland Cement Co.
Dockery, L. A., '95..........................*Chihauhua, Mexico*
Mining Engineer.
Dollison, James E., '98..............................*Alma, Colo.*
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Dow, William G., '06...........................*Eden, Wyoming*
Chief Engineer, Eden Irrigation and Land Co.
Downer, Roger H., '01...................*Box 175, Goldfield, Nev.*
Doyle, Donald B., '09.....................*Santa Rita, New Mexico*
Chino Copper Co.
Draper, Marshall D., '97.........*745 Equitable Bldg., Denver, Colo.*
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Drescher and Wolfersberger, Mining Engineers.
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Durell, Charles T., '95.................*Baquio, Philippine Islands*
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Dwelle, Jesse E., '96.............*703 Symes Building, Denver, Colo.*
Empire Zinc Co.
Dyer, Charles E., '10............................*Park City, Utah*
Little Bell Mining Co.

Eames, L. B., '05................*728 Equitable Bldg., Denver, Colo.*
Dorr Cyanide Machinery Co.
East, John H., Jr., '10..........................*Painter, Wyoming*
Winona Gold-Copper M. and M. Co.
Eaton, Albert L., '95...................*Box 13, Chihuahua, Mexico*
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Eddy, Harold C., '09.......................*Box 963, Denver, Colo.*
Ehle, Mark, Jr., '01..........................*Rapid City, S. Dak.*
Professor of Mining, South Dakota School of Mines.
Ehrich, Walter L., '02...........*463 Fifth Ave., New York, N. Y.*
Elder, Robert B., '08..........................*Washington, D. C.*
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Ellis, William W., '02.................*535 17th St., Denver, Colo.*
Ellsworth, Alfred C., '08............................*Pueblo, Colo.*
Ellsworth-Klanor Construction Co.
Emeis, Walter A., '04...........................*Platteville, Wis.*
Superintendent, Calemesis Mining Co.
Emens, Ray B., '07...........................*Searchlight, Nevada*
Walter M. Brown Engineering Co.
Emrich, Clarence T., '09............................*Golden, Colo.*
North American S. and M. Co.
Emrich, Horace H., '03..........................*Kishtim, Russia*
Manager, Copper Refinery, Kishtim Mining Works.
Enriquez, Eduardo W., '09.............*Yoquiro, Chihuahua, Mexico*
Estes, Frank M., Jr., '02...........*5227 McPherson, St. Louis, Mo.*
Evans, Henry R., '00.
Evans, Willis W., '08.
Deceased.
Everest, Herbert A., '08....*511 E. Tenth St., Oklahoma City, Okla.*
Ewing, Charles R., '00..........................*Del Norte, Colo.*
Eye, Clyde M., '95..................*Arroy, Island of Masbate, P. I.*
Superintendent, Colorado Mining Co.
Farnam, Franklin C., '09.........................*Chisholm, Minn.*
Oliver Iron Mining Co.
Farrar, Russell J., '10............................*Salem, Oregon*
Febles, John C., '97.........................*Box 105, Butte Mont.*
Anaconda Copper Co.
Field, Fred M., '95...................*872 24th St., Ogden, Utah*
Fillius, Lee L., '04...............................*Telluride, Colo.*
Cyanide Department, Smuggler Union Co.
Filteau, C. A., '07.. ....*San Jose de Gracia, Sinaloa, Mexico*
Cia Minera Jesus Maria y Anexas.
Finigan, William H., '06.......................*Kelly, New Mexico*
Fitz Gerald, R. P., '10..............................*Ray, Arizona*
Ray Consolidated Copper Co.
Fleming, William L., '03............*66 Broadway, New York, N. Y.*
Manager, Mines Report Bureau.

Flint, F. F., '05....................*R. F. D. No. 4, Greeley, Colo.*

Floyd, John A., '88.

Deceased.

Ford, Homer D., '05..........................*Howardsville, Colo.*

Superintendent, Old Hundred Mine.

Foster, George C., '03..............*521 E. 18th Ave., Denver, Colo.*

Franck, Albert C., '04..............*3408 6th St., San Diego, Calif.*

Franck, Robert P., '04...

Frank, Harry L., '01...........*37 Jacobson Building, Denver, Colo.*

Frank, Morton E., '06..........*451 Drexel Boulevard, Chicago, Ill.*

Freeland, William H., '06.

Deceased.

French, Burr J., '08....................*Canelas, Durango, Mexico*

French, Sidney W., '08..........................*Greenville, Calif.*

Frick, Frederick F., '08..........................*Anaconda, Mont.*

New Reduction Works, Anaconda Copper M. Co.

Friedhoff, W. H., '07.............*652 So. Virginia St., Reno, Nev.*

Fry, Louis D., '03...

Funk, Walter A., '03............................*Idaho Falls, Idaho*

Mining Engineer and U. S. Mineral Surveyor.

Gardner, John I., '06...............*1984 Holden St., Denver, Colo.*

Garza, Adalpe J. M., '05........*Box 225, Torreon, Coahuila, Mexico*

Mining Engineer.

Geary, Richard E., '05.......*404 Oregonian Bldg., Portland, Oregon*

Gehrmann, Charles A., '86....*Mills Building, San Francisco, Calif.*

Geisel, C. R., '07.................*2714 E. 13th Ave., Denver, Colo.*

Denver Union Water Co.

Geringer, George T., '10............................*Wilhurst, Ky.*

Premier Coal and Lumber Co.

Giddings, Donald S., '00............................*Victor, Colo.*

New Portland Mill, Portland Gold Mining Co.

Gilbert, Arthur K., '06.......................*Sweetwater, Nevada*

Gilbert, William J., '06....................*Box 642, Greeley, Colo.*

Glasgow, Charles M., '10....*4371 Washington Ave., St. Louis, Mo.*

Goe, Harold H., '08......................*Box 80, Anaconda, Mont.*

New Reduction Works, Anaconda Copper Mining Co.

Golden, John P., '07...............*522 Quincy Bldg., Denver, Colo.*

Mineral Inspector, U. S. General Land Office.

Goodale, Frank A., '10..............................*Delta, Colo.*

Chief Engineer, Delta Land Co.

Goodale, Stephen L., '04..........*Grant Boulevard, Pittsburg, Pa.*

Professor of Metallurgy and Ore Dressing, University of Pittsburg.

Gordon, John G., Jr., '06.................*Guanajuato, Gto., Mexico*

Gow, Paul A., '07...................................*Butte, Mont.*

Engineer, Amalgamated Copper Mining Co.

Grant, Lester S., '99...............................*Victor, Colo.*

Superintendent, Isabella Gold M. Co.

Gray, Latimer D., '95........................*Rock Springs, Wyo.*
Manager, Electric Department, U. P. Coal Co.
Greve, E. E., '05...................*492 First St., Brooklyn, N. Y.*
Grider, R. L., '05............................*Cutter, New Mexico*
Vanadium Mines Co.
Griffith, John R., '09............................*Eden, Wyoming*
Eden Irrigation and Land Co.
Griswold, George G., '96...........................*Keeler, Calif.*
Grommon, Philo D., '07...............*4025 18th Ave., Denver, Colo.*
Gross, John, '97..............*745 Equitable Building, Denver, Colo.*
Draper and Gross, Mining and Metallurgical Engineers.
Hallett, Alfred F., '09.............................*Kokomo, Colo.*
Kokomo Metals Co.
Hallett, R. L., '05............................*Humboldt, Arizona*
Arizona Smelting Co.
Hallett, William J., '05....................*Rock Springs, Wyoming*
Acting Chief Engineer, U. P. Coal Co.
Hamilton, Frank R., '98.......................................
Hamilton, Wm. J., '09........................*Grand Forks, B. C.*
Granby Smeltery.
Hammond, Wm. L., '09.........................*Saguache, Colo.*
Hansen, Charles L., '09.......................*Searchlight, Nevada*
Quartette Mining Co.
Harkison, Charles W., '06.......*Fustin P. O., Blaine County, Idaho*
Muldoon Mining Co.
Harrington, Daniel, '00...*301 Brooks Arcade, Salt Lake City, Utah*
Mining Engineer.
Harrington, Orville, '98......*1485 S. University St., Denver, Colo.*
U. S. Mint.
Harris, Morrison, '08................*St. Martin, Philadelphia, Pa.*
Harris, Willard F., '01................*Independent, Dgo., Mexico*
General Manager, Independent Gold Mining Co.
Harrison, Thomas S., '08........................*Wiley, Wyoming*
Hartzell, Lester J., '95.............................*Butte, Mont.*
Assistant Professor of Chemistry, Montana School of Mines.
Hawley, R. Howard, '93.
Hazard, William J., '97............................*Golden, Colo.*
Professor of Electrical Engineering, Colorado School of Mines.
Heitz, George H., '06...................*Box 526, Leadville, Colo.*
McNair & Heitz, Mining Engineers.
Hensley, James H., '06..........................*Miami, Arizona*
Miami Copper Co.
Hewitt, A. F., '05....................*State Capitol, Denver, Colo.*
Deputy State Engineer.
Hill, Frank C., '04..........................*Salt Lake City, Utah*
Chief Engineer, Clear Creek Mine, Utah Fuel Co.
Hills, Leon P. '08.
Hilton, Howard J., '10.............................*Vernal, Utah*
Hindry, Willis E., '92.............*Slavin Building, Pasadena, Calif.*
Mining Engineer.

Hodgson, Arthur, '99..............................*Denver, Colo.*
Assayer, U. S. Mint.
Hollis, D. D., '07..............*712 E. & C. Building, Denver, Colo.*
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Howat, A. M., '07.............. ....*Kingman, Arizona*
Needles Mining and Smelting Co.
Hoyt, George F., '96.
Hubbard, John V., '10........... *1234 W. Kinzie St., Chicago, Ill.*
Hull, Cecil B., '09............*618 E. & C. Building, Denver, Colo.*
Hunt, H. V. D., '09...............................*Garfield, Utah*
Garfield Smeltery.
Hunt, T. R., '05..........................*Ione, Amador Co., Calif.*
Mill Superintendent.
Hyder, C. A., '05................ .....*Moctezuma, Sonora, Mexico*
Hyder and Hyder, Mining Engineers.
Hyder, Frederick B., '03.......... ..... *Nacozari, Sonora, Mexico*
Manager, Dawson Mining Co.
Ickis, Harry M., '02.
Deceased.
Ingersoll, Julius C., Jr., '06.........................*Ouray, Colo.*
Ingersoll and Bell, Mining Engineers.
Ingols, J. August, '98..............................*Milford, Utah*
General Superintendent, Majestic Copper M. and S. Co.
Ireland, Carrol B., '08..........*2611 W. Argyle Place, Denver, Colo.*
Isom, E. W., '07.......................*Dawson, Yukon Territory*
Yukon Consolidated Gold Fields Co.
Iwai, Kyosuke, '09.........................*Tsukiji, Tokyo, Japan*
Yoshinotani Coal Mining Co., Ltd.
Izett, Glenn, '03............*Gas and Electric Building, Denver, Colo.*
Jackson, Walter H., '01..........*Mapimi, Ojuela, Durango, Mexico*
Mining Engineer, Compania Minera de Penoles.
Jacques, Henry L., '08..............................*Mojave, Calif.*
Los Angeles Acqueduct.
Jarvis, Royal P., '97..............................*Knoxville, Tenn.*
Professor of Mining and Metallurgy, University of Tennessee.
Jewel, Gilbert E., '93.
Johnson, Byron M., '08...........................*Leadville, Colo.*
American Zinc Extraction Co.
Johnson, Edward W., '91...................*Salt Lake City, Utah*
Superintendent, Garfield Smelting Co.
Johnson, Gilbert, Jr.
Deceased.
Johnson, Junius W., '01................*State Capitol, Denver, Colo.*
Deputy State Engineer.
Johnson, Lafayette G., '04........................*Flat River, Mo.*
Engineer, Federal Lead Co.
Johnston, Fred, '98..............................*Leadville, Colo.*
Assistant Superintendent, Arkansas Valley Plant, A. S. and R. Co.
Jones, Edward B., '00....*326-27 Dooly Block, Salt Lake City, Utah*

Jones, Ernest F., '10............*Los Esperanzas, Coahuila, Mexico*

Jones, Mrs. F. H., '98.

Jones, Frank H., '98.

Jones, Fred, '00..................................*Victor, Colo.*
Engineer, Portland G. M. Co.

Jones, I. Percy, '08..............................*Tucson, Arizona*
Arizona Eastern R. R. Co.

Jones, Vincent K., '10.....*5-6 Crockett Bldg., East Las Vegas, N. M.*
Chief Engineer, Placita Ranch and Beck Grant Irrigation Project.

Jones, W. Ashby, Jr., '08........................*Ware Neck, Va.*

Juchem, Harold H., '10......................*Poza, Sonora, Mexico*
El Tajo Mining Co.

Keeney, Robert M., '10.............................*Golden, Colo.*
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Kell, Wayne S., '06...................................*Atlanta, Ga.*
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Kelso, Duane C., '10..............................*Telluride, Colo.*

Kennedy, George A., '95..........*2749 Boulevard F, Denver, Colo.*
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Assistant Superintendent, Mexican Exploration Syndicate, Ltd.

Kerr, Victor E., '00...............................*Golden, Colo.*

Kilbourn, William D., '04.........................*Murray, Utah*
Murray Plant, A. S. and R. Co.

Kilgour, M. Hamilton, '08....*16 Exchange Place, New York, N. Y.*
Canadian Bank of Commerce.

Kimball, George K., '92......................*Idaho Springs, Colo.*
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Kimball, Harlow M., '04....*500 Constitution Bldg., Salt Lake, Utah*

Kimball, Joseph S., '92................*Box 376, Central City, Colo.*

King, Henry E., '03......*419 E. Kiowa St., Colorado Springs, Colo.*
Hydro-Electric Power Co.

Kingman, Jerry, '88.
Deceased.

Kirchman, Robert I., '09.................*Santa Rita, New Mexico*
Chino Copper Co.

Kleff, J. Marvin, '06.....................*Box 804, Leadville, Colo.*

Knight, Hal G., '08..............................*Porcupine, Alaska*

Knight, R. E., '07.................................*Alliance, Neb.*
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Knowles, Benjamin W., '08.........................*Hedley, B. C.*
Daly Reduction Co.

Koerner, Albert J., '06...........................*Saginaw, Mich.*

Kraemer, Edward L., '98..........................*Bingham, Utah*
Yampa Smelting Co.

Krueger, G. S., '07.

Kruger, Herman A., '09.................. *Ojuela, Durango, Mexico*
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Langrall, Charles A., '08............................ *Ray, Arizona*
Lannon, F. P., Jr., '07............................. *Pueblo, Colo.*
U. S. Zinc Smeltery.
Larison, E. L., '05............................. *Isabella, Tenn.*
D. S. C. & I. Co.
Larsh, Walter S., '04......................... *Hamilton, Nevada*
Manager, Metals Exploration Co.
Latimer, B. J., '10......................... *Llera, Tampa, Mexico*
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B. and M. Mining Co.
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Granby Smeltery.
Lee, Robert P., '05......................... *Box 53, Ely, Nevada*
Lee, Wallace, '04......................... *Ures, Sonora, Mexico*
Wendler and Lee, Mining Engineers.
Leeke, Dana W., '10............................. *Garfield, Utah*
Utah Consolidated Mining Co.
Lehmer, Frank W., '02................... *Ocotlan, Oaxaca, Mexico*
Manager, Compania Minera Zapoteca.
Lemke, Carl '00.................................. *Leadville, Colo.*
Superintendent, American Zinc Extraction Co.
Lennox, L. W., '05................................. *Victor, Colo.*
New Portland Mill, Portland Gold M. Co.
Lerchen, F. H., '97................................. *Kelley, N. M.*
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Lewis, Alfred S., '05............................. *Hatchita, N. M.*
La Ventura Mines Co.
Lewis, Frank E., '01..............*1007 So. Race St., Denver, Colo.*
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Libby, James L., '06......................... *Rock Springs, Wyo.*
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Liddell, T. Parker, '03.................... *Battle Mountain, Nevada*
Liddell and Liddell, Mining Engineers.
Liddell, Charles A., '03......................... *Manhattan, Nevada*
Liddell and Liddell, Mining Engineers.
Limbach, Edmund C., '95.......................... *Loomis, Wash.*
Link, Karl G., '08..........*Apartado 25, Guanajuato, Gto. Mexico*
Logue, N. W., '97.

Lonergan, P. Jay, Jr., '05. . . . .*Golden, Colo.*
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Lorah, Bela J., '88.
Deceased.
Lovering, Ira G., '01. . . . .*Apartado 21, Sabinas, Coah., Mexico*
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Lucy, Frank A., '01.
Deceased.
Lucy, Richard W., '98. . . . .*1127 Bannock St., Denver, Colo.*
MacGregor, George H., '97. . . . .*Drake, Colo.*
Magenau, William, '98. .*Apartado 30, Gomez Palacio, Durango, Mex.*
Malmstrom, C. Clarence, '00. . . . . .*1109 E. 13th Ave., Denver, Colo.*
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